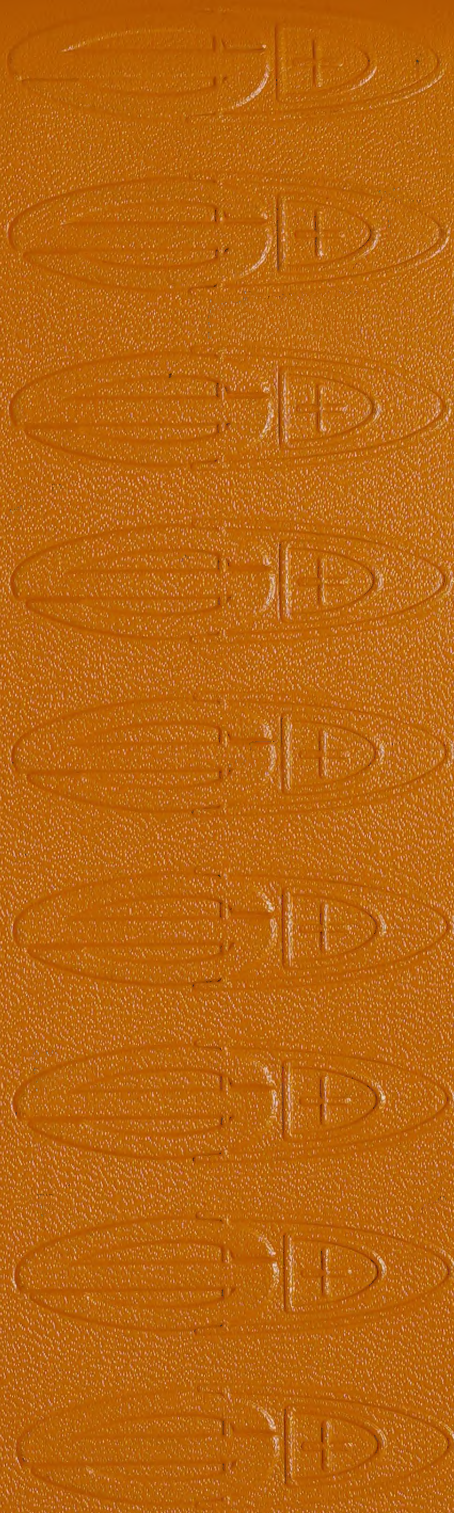


SYSTRON DONNER

OPERATION AND SERVICE MANUAL

© Copyright 1978
SYSTRON DONNER CORPORATION
ONE SYSTRON DRIVE
CONCORD, CALIFORNIA 94518 USA

MODEL 5000A

SWEEPER MAINFRAME

MICROWAVE DIVISION

SYSTRON DONNER CORPORATION

TEST AND MEASUREMENT GROUP

PRINTED December 15, 1978
MANUAL P/N 950783

SYSTRON DONNER
CORPORATION

EQUIPMENT WARRANTY

Seller warrants equipment of its manufacture against defective materials or workmanship for a period of one year from date of shipment.

The liability of Seller under this warranty is limited, at Seller's option, solely to repair, replacement with equivalent Systron-Donner equipment, or an appropriate credit adjustment not to exceed the original equipment sales price, of equipment returned to the Seller, provided that:

> The defective equipment is returned to Seller's designated repair location, transportation charges prepaid by Buyer, and
>
> Seller's examination of such equipment discloses to its satisfaction that defects were not caused by negligence, misuse, improper installation, accident, or unauthorized repair or alteration by Buyer.

In no event shall Seller be liable for collateral or consequential damages due to defective equipment.

This warranty does not include mechanical parts failing from normal usage, nor does it cover limited-life electrical components which deteriorate with age, such as vacuum tubes, batteries, lamps, or accessories not manufactured by the Seller, but which are furnished with the Seller's equipment. Seller's liability is limited to whatever warranty is extended by the manufacturers thereof and transferable to the Buyer.

This warranty is applicable to the original Buyer only and constitutes the sole and exclusive warranty of Seller.

This warranty is in lieu of any other warranty, expressed, implied, or statutory, and no agreement extending or modifying it will be binding upon Seller unless in writing and signed by a duly authorized officer.

Systron-Donner Corporation
Microwave Division
14844 Oxnard Street
Van Nuys, CA 91411

LIST OF EFFECTIVE PAGES

PAGE	CHANGE
Title	Original
1-1 through 1-12	Original
2-1 through 2-4	Original
3-1 through 3-25	Original
3-26	Blank
4-1 through 4-3	Original
4-4	Blank
4-5 through 4-7	Original
4-8	Blank
4-9 through 4-11	Original
4-12	Blank
4-13 through 4-17	Original
4-18	Blank
4-19 through 4-25	Original
4-26	Blank
5-1 through 5-40	Original
6-1 through 6-3	Original
6-4	Blank
6-5	Original
6-6	Blank
6-7	Original
6-8	Blank
6-9	Original
6-10	Blank
6-11	Original
6-12	Blank
7-1 through 7-9	Original
7-10	Blank
7-11 through 7-20	Original
8-1 through 8-3	Original
8-4	Blank
8-5	Original
8-6	Blank
8-7	Original
8-8	Blank
8-9	Original
8-10	Blank
8-11	Original
8-12	Blank
8-13	Original
8-14	Blank
8-15	Original
8-16	Blank
8-17	Original
8-18	Blank
8-19	Original
8-20	Blank
8-21	Original
8-22	Blank
8-23	Original
8-24	Blank
8-25	Original
8-26	Blank
8-27	Original
8-28	Blank

NOTE 1: All Original pages were published December 15, 1978

NOTE 2: Please report errors and omissions in this manual to:

Systron-Donner Corporation
Microwave Division
14844 Oxnard Street
Van Nuys, CA 91411

This report should include the manual title, date of last change, and exact location (by page, paragraph, line, or figure) of the error. Also include the model number, serial number, and numbers of modifications or options (if any) pertinent to your instrument.

TABLE OF CONTENTS

SECTION/ PARAGRAPH	TITLE	PAGE
SECTION I	GENERAL INFORMATION	1-1
1-1.	SCOPE	1-1
1-2.	DESCRIPTION OF EQUIPMENT	1-1
1-3.	CAPABILITIES AND PERFORMANCE	1-2
1-3.1	External Power Requirements	1-2
1-3.2	Output Range	1-2
1-3.3	Wide Sweep Capacity	1-2
1-3.4	Multiple Sweep Modes	1-2
1-3.5	Extended Sweep Rates	1-3
1-3.6	Sweep Trigger Modes	1-3
1-3.7	Amplitude Modulation Modes	1-3
1-3.8	Display Blanking Output	1-3
1-3.9	Optional Configurations	1-3
1-3.9.1	Option M1 Negative Blanking	1-3
1-3.9.2	Option M3 Positive Tuning Reference	1-3
1-3.9.3	Option M10 Remote Connectors	1-3
1-3.9.4	Option M16 Extended Power Line Frequency Range	1-3
1-4.	ACCESSORIES	1-3
1-4.1	Accessories Supplied with 5000A	1-3
1-4.1.1	Extender Board	1-3
1-4.1.2	Phase Lock Plug	1-4
1-4.2	Optional Accessories	1-4
1-4.2.1	Model 9001 Storage Cabinet	1-4
1-4.2.2	Model 9002 Rack Adapter Cabinet	1-4
1-4.2.3	Model 9004 Rack Mounting Kit	1-4
1-4.2.4	Model 9016 Rack Mounting Kit	1-4
1-4.2.5	Model 9107 Pen Lift Relay	1-4
1-4.2.6	Model 9041 Transit Case	1-4
1-4.2.7	Model 9201 Test Plug-in	1-4
1-4.2.8	Model 9202 Extender	1-4
1-4.2.9	Model 9203 Inverter	1-4
1-4.2.10	Flexible Plug-in Extension	1-4
1-4.2.11	Model 9210 Calibration Dial	1-4
SECTION II	INSTALLATION	2-1
2-1.	UNPACKING AND INSPECTION	2-1
2-1.1	Removing Contents	2-1
2-1.2	Visual Inpsection	2-1
2-1.3	Electrical Inspection	2-1
2.2	PREPARATION FOR USE	2-1
2-2.1	Normal Line Voltage Operation	2-1
2-2.2	Low Line Voltage Operation	2-1
2-2.3	Instrument Grounding	2-2
2-2.4	Manual Scan Quieting Disable	2-2
2-2.5	Plug-in Unit Installation	2-3
2-3.	MOUNTING	2-3
2-3.1	Bench Use	2-3
2-3.2	Rack Mounting	2-3

TABLE OF CONTENTS (Continued)

SECTION/ PARAGRAPH	TITLE	PAGE
SECTION II	INSTALLATION (Continued)	
2-4.	PACKAGING FOR SHIPMENT	2-3
2-5.	SHIPPING METHOD	2-4
2-6.	INSURANCE	2-4
2-7.	RETURNS FOR REPAIR	2-4
SECTION III	OPERATING INSTRUCTIONS	3-1
3-1.	SCOPE	3-1
3-2.	FRONT PANEL CONTROLS AND INDICATORS	3-1
3-3.	REAR PANEL CONTROLS AND INDICATORS	3-1
3-4.	INITIAL OPERATING PROCEDURES	3-1
3-5.	HINTS AND PRECAUTIONS	3-1
3-5.1	Changing Plug-ins	3-1
3-5.2	Power Supply Overloads	3-15
3-5.3	Sweep Outputs	3-15
3-5.4	Display Blanking	3-15
3-5.5	Line Trigger Operation	3-16
3-5.6	External Sweep	3-16
3-5.6.1	External Sweep Bandwidth	3-17
3-5.6.2	External Sweep Operating Modes	3-17
3-5.6.3	Frequency Calibration	3-17
3-5.6.4	Vernier	3-18
3-5.6.5	Phase Lock	3-18
3-5.7	Sweep Frequency Limits	3-18
3-5.7.1	Wide F1—F2 Mode	3-18
3-5.7.2	Fc ± ΔF Mode	3-19
3-5.7.3	Limitations on Accuracy	3-20
3-5.8	Markers	3-20
3-5.8.1	Direct Trace Marking	3-21
3-5.8.2	Heterodyne Marker	3-21
3-5.8.3	Comb Markers	3-21
3-5.8.4	Cavity Wavemeter	3-21
3-5.8.5	RF Dip Markers	3-21
3-5.8.6	Video Bypass Markers	3-21
3-5.8.7	Intensity Markers	3-24
3-5.9	Sweeping Current Supply	3-24
3-5.9.1	Installation	3-24
3-5.9.2	Wide F1—F2 Mode	3-24
3-5.9.3	CW Mode	3-25
3-5.9.4	Fc ± ΔF Sweep Mode	3-25
3-5.9.5	Vernier	3-25
3-5.9.6	Markers	3-25
3-5.9.7	Sweep Trigger	3-25
3-5.9.8	Blanking Output	3-25
3-5.9.9	Reference Outputs	3-25

TABLE OF CONTENTS (Continued)

SECTION/ PARAGRAPH	TITLE	PAGE
SECTION IV	CIRCUIT DESCRIPTION	4-1
4-1.	OVERALL FUNCTIONAL DESCRIPTION	4-1
4-1.1	Power Supplies	4-2
4-1.2	Ramp Generator	4-2
4-1.2.1	Trigger	4-5
4-1.2.2	Sweep Outputs	4-5
4-1.2.3	Blanking	4-5
4-1.2.4	Manual Scan	4-5
4-1.2.5	Manual Scan Quieting	4-5
4-1.2.6	Component Location	4-5
4-1.3	Mode Generator	4-5
4-1.3.1	Wide F1—F2 Mode	4-5
4-1.3.2	CW Mode	4-6
4-1.3.3	Fc ± ΔF Mode	4-6
4-1.3.4	CW Quieting	4-6
4-1.3.5	Component Location	4-6
4-1.4	Marker Generator	4-6
4-2	DETAILED FUNCTIONAL DESCRIPTION	4-6
4-2.1	Power Supplies	4-6
4-2.1.1	Input Conditioning	4-6
4-2.1.2	Plus 250 Volt Supply	4-9
4-2.1.3	Line Trigger Reference	4-9
4-2.1.4	Plus 20 Volt Supply	4-9
4-2.1.5	Minus 20 Volt Supply	4-10
4-2.1.6	Plus 30 Volt Supply	4-10
4-2.2	Ramp Generator	4-10
4-2.2.1	Integrator	4-10
4-2.2.2	Vernier	4-13
4-2.2.3	Blanking	4-13
4-2.2.4	Recurrent Mode	4-13
4-2.2.5	Delay Generator	4-14
4-2.2.6	Line Trigger Mode	4-14
4-2.2.7	External Trigger Mode	4-14
4-2.2.8	Manual Trigger Mode	4-14
4-2.2.9	Manual Scan	4-14
4-2.2.10	Manual Scan Quieting	4-16
4-2.2.11	CW Mode	4-16
4-2.2.12	CW Quieting	4-16
4-2.3	Mode Generator	4-16
4-2.3.1	Signal Flow, Internal Sweep Mode	4-16
4-2.3.2	Signal Flow, External Sweep Mode	4-16
4-2.3.3	Signal Flow, Wide F1—F2 Mode	4-16
4-2.3.4	Signal Flow, CW Mode	4-21
4-2.5	Marker Generator	4-23

TABLE OF CONTENTS (Continued)

SECTION/ PARAGRAPH	TITLE	PAGE
SECTION V	PERFORMANCE CHECKS AND CALIBRATION	5-1
5-1.	GENERAL	5-1
5-2.	PERFORMANCE CHECKS	5-1
5-2.1	Equipment Required	5-1
5-2.2	Initial Setup	5-1
5-2.2.1	Description	5-1
5-2.2.2	Procedure	5-4
5-2.3	Power Supply Performance Checks	5-4
5-2.3.1	Description	5-4
5-2.3.2	General Test Method	5-5
5-2.3.3	Initial Setup	5-5
5-2.3.4	Plus 250 Volt Power Supply Check	5-5
5-2.3.5	Plus 20 Volt Power Supply Check	5-6
5-2.3.6	Minus 20 Volt Power Supply Check	5-6
5-2.3.7	Plus 30 Volt Power Supply Check	5-6
5-2.4	Ramp Generator Performance Checks	5-7
5-2.4.1	Description	5-7
5-2.4.2	Sweep Time Check	5-7
5-2.4.3	Sweep Amplitude Check	5-8
5-2.4.4	Blanking Check	5-9
5-2.4.5	Sweep Trigger Check	5-9
5-2.4.6	Manual Scan Check	5-10
5-2.5	Mode Generator Performance Check	5-10
5-2.5.1	Description	5-10
5-2.5.2	CW Mode Check	5-10
5-2.5.3	CW Mode Noise Check	5-11
5-2.5.4	Wide F1—F2 Mode Check	5-11
5-2.5.5	Fc ± ΔF Mode Check	5-11
5-2.6	Marker Performance Checks	5-12
5-2.6.1	Description	5-12
5-2.6.2	Wide F1—F2 Sweep Mode	5-12
5-2.6.3	Fc ± ΔF Sweep Mode	5-14
5-3.	CALIBRATION	5-15
5-3.1	General	5-15
5-3.2	Equipment Required for Calibration	5-15
5-3.3	Location of Components and Adjustments	5-15
5-3.4	General Procedure for Selection of Component Values	5-15
5-3.5	Power Supply Calibration	5-21
5-3.5.1	Initial Procedures	5-21
5-3.5.2	Plus 20 Volt Power Supply	5-21
5-3.5.3	Minus 20 Volt Power Supply	5-23
5-3.5.4	Plus 30 Volt Power Supply	5-25
5-3.6	Ramp Generator Calibration	5-26
5-3.6.1	Initial Procedures	5-26
5-3.6.2	External/Manual/Line Trigger Zero	5-27
5-3.6.3	Recurrent Trigger Zero	5-28
5-3.6.4	Sweep Ramp Amplitude	5-29
5-3.6.5	Sweep Start Delay	5-31
5-3.6.6	Manual Scan	5-31

TABLE OF CONTENTS (Continued)

SECTION/ PARAGRAPH	TITLE	PAGE
SECTION V	PERFORMANCE CHECKS AND CALIBRATION (Continued)	
5-3.7	Mode Generator Calibration	5-32
5-3.7.1	Initial Procedures	5-32
5-3.7.2	F1—F2 and ΔF Input Offset	5-33
5-3.7.3	ΔF Offset and Gain	5-35
5-3.8	Dial Calibration	5-36
5-3.8.1	Initial Steps	5-36
5-3.8.2	F1—Start Control	5-36
5-3.8.3	F2—Stop Control	5-37
5-3.8.4	Marker 2—Fc Control	5-38
5-3.8.5	Marker 1 Control	5-39
5-3.8.6	Marker 3 Control	5-39
SECTION VI	MAINTENANCE	6-1
6-1.	GENERAL	6-1
6-2.	ROUTINE MAINTENANCE	6-1
6-3.	CALIBRATION	6-1
6-4.	CORRECTIVE MAINTENANCE	6-1
6-4.1	Trouble Isolation	6-1
6-4.1.1	Trouble Isolation Process	6-1
6-4.1.2	Supporting Information	6-2
6-4.1.3	Trouble Isolation Diagrams	6-2
6-4.2	Test Equipment	6-2
6-4.3	Printed Circuit Board Repair	6-3
6-4.4	Component Removal and Re-assembly	6-3
SECTION VII	REPLACEABLE PARTS LISTS	7-1
7-1.	INTRODUCTION	7-1
7-2.	ORDERING REPLACEMENT PARTS	7-1
7-3.	EXPLANATION OF COLUMNS	7-1
7-3.1	Fig. No/Item No.	7-1
7-3.2	Ref. Desig.	7-1
7-3.3	Use Code	7-1
7-3.4	Systron-Donner Part Number	7-1
7-3.5	Mfr's Part Number	7-1
7-3.6	Mfr. Code	7-2
7-3.7	Description	7-2
7-3.8	Qty.	7-2
7-4.	PARTS BREAKDOWN	7-2
SECTION VIII	PARTS LOCATION/SCHEMATIC DIAGRAMS	8-1

LIST OF ILLUSTRATIONS

FIGURE	TITLE	PAGE
1-1	Model 5000A Sweeper Mainframe	1-1
3-1	Front-Panel Controls and Indicators	3-2
3-2	Rear-Panel Controls and Connectors	3-8
3-3	Initial Operating Procedures	3-12
3-4	Heterodyne and RF Dip Marker Characteristics	3-22
3-5	Typical Setup	3-23
3-6	Amplitude and Intensity Marker Characteristics	3-23
4-1	Model 5000A Functional Block Diagram	4-3
4-2	Power Supply Simplified Schematic Diagram	4-7
4-3	Ramp Generator Simplified Schematic Diagram	4-11
4-4	Ramp Generator Timing Diagram	4-15
4-5	Mode Generator Simplified Schematic Diagram	4-17
4-6	Mode Generator Timing Diagram	4-19
4-7	ΔF Timing Diagram	4-22
4-8	Marker Generator Simplified Schematic Diagram	4-25
5-1	Power Supply Dummy Load Schematic Diagram	5-3
5-2	Sweep Ramp Waveform	5-7
5-3	Location of Components, Adjustments, and Reference Test Points	5-17
5-4	A5 Board Calibration Component Location	5-22
5-5	A6 Board Calibration Component Location	5-26
5-6	A9 Board Calibration Component Location	5-28
5-7	A2 Board Calibration Component Location	5-30
5-8	A8 Board Calibration Component Location	5-34
6-1	Troubeshooting Diagrams	6-5
7-1	Model 5000A Illustrated Parts Breakdown	7-5
8-1	Chassis Parts Terminal Connections	8-2
8-2	5000A Chassis Wiring Diagram	8-3
8-3	5000A Overall Schematic	8-7
8-4	Timing Capacitor Board Assembly A1 Parts Location/Schematic Diagram	8-9
8-5	Trigger-Sweep Board Assembly A2 Parts Location/Schematic Diagram	8-11
8-6	Single Operational Amplifier Board Assembly A3 Parts Location/ Schematic Diagram	8-13
8-7	Triple Marker Generator Board Assembly A4 Parts Location/Schematic Diagram	8-15
8-8	Dual Precision Regulator Board Assembly A5 Parts Location/Schematic Diagram	8-17
8-9	Single Precision Regulator Board Assembly A6 Parts Location/Schematic Diagram	8-19
8-10	Power Supply Board Assembly A7 Parts Location/Schematic Diagram	8-21
8-11	Dual Operational Amplifier Board Assembly A8 Parts Location/Schematic Diagram	8-23
8-12	Sweep-Second Board Assembly A9 Parts Location/Schematic Diagram	8-25
8-13	Overcurrent Limit Board Assembly A10 Parts Location/Schematic Diagram	8-25
8-14	Model 5000A Options Parts Location/Schematic Diagrams	8-27

LIST OF TABLES

TABLE	TITLE	PAGE
1-1	Performance Specifications	1-5
3-1	Front-Panel Controls and Indicators	3-3
3-2	Rear-Panel Controls and Connectors	3-9
5-1	Performance Checks	5-2
5-2	Test Equipment Required for Performance Checks	5-2
5-3	Calibration Procedures	5-16
5-4	Test Equipment Required for Calibration	5-16
7-1	Model 5000A Use Codes	7-2
7-2	Manufacturers' Codes	7-3
7-3	Model 5000A Chassis Parts List	7-7
7-4	Timing Capacitor Board Assembly A1 Parts List	7-11
7-5	Trigger-Sweep Board Assembly A2 Parts List	7-12
7-6	Single Operational Amplifier Board Assembly A3 Parts List	7-13
7-7	Triple Marker Generator Board Assembly A4 Parts List	7-14
7-8	Dual Precision Regulator Board Assembly A5 Parts List	7-15
7-9	Single Precision Regulator Board Assembly A6 Parts List	7-16
7-10	Power Supply Board Assembly A7 Parts List	7-16
7-11	Dual Operational Amplifier Board Assembly A8 Parts List	7-17
7-12	Sweep-Second Board Assembly A9 Parts List	7-18
7-13	Overcurrent Limit Board Assembly A10 Parts List	7-18
7-14	Extender Board Assembly A11 Parts List	7-19
7-15	Dial Assembly A12 Parts List	7-19
7-16	Blanking Inverter Board Assembly A13 (Option M1) Parts List	7-20
7-17	Positive Reference Output Board Assembly A14 (Option M3) Parts List	7-20

SECTION I

GENERAL INFORMATION

1-1. SCOPE

This manual provides general information, installation data, operating instructions, circuit descriptions, maintenance data, performance checks, calibration procedures, parts lists, and circuit diagrams for the Systron-Donner (Microwave Division) Model 5000A Sweeper Mainframe.

The Model 5000A Sweeper Mainframe, hereinafter referred to as the Model 5000A, the 5000A, or the mainframe, is shown in Figure 1-1 with a typical RF plug-in installed. Instruction manuals for the various RF and adapter plug-ins are supplied separately with each plug-in, and the information contained in these manuals is not duplicated herein.

Figure 1-1. Model 5000A Sweeper Mainframe

1-2. DESCRIPTION OF EQUIPMENT

The Model 5000A accepts a variety of swept RF generator plug-in units operating over the 100 kilohertz to 26.5 gigahertz region. Each RF plug-in is supplied with a plastic frequency dial scale calibrated for the range of the plug-in. This dial scale is attached to the mainframe with the plug-in for simple frequency range changes.

Major subassemblies of the 5000A are the power supply module, the power supply regulator boards and rear-panel mounted regulator transistors, two sweep generator boards, three mode generator boards, a marker generator board, the dial system assembly, and front-panel mounted operating mode switches. Most of the printed circuit assemblies are interconnected with the 5000A through chassis-mounted board-edge connectors.

1-3. CAPABILITIES AND PERFORMANCE

The Model 5000A provides versatile power supply and control signal outputs for operation of swept microwave RF sources to cover the electromagnetic spectrum presently in common use. These RF sources are intended for use in laboratory or field tests of electronic communications components, subsystems, and systems by offering a precisely-calibrated alternative to time-consuming point-by-point testing of amplitude versus frequency characteristics over wide ranges.

The power supplies provide four separate outputs for maximum versatility of plug-in operation.

Detailed performance specifications for the Model 5000A are given in Table 1-1. Detailed performance specifications for the various RF and sweeping current supply plug-in units are supplied in the applicable manuals.

Salient features of the 5000A are summarized in the following paragraphs.

1-3.1 External Power Requirements

The 5000A operates from sinusoidal single-phase 50 or 60 Hertz (to 400 Hertz on special order) power lines supplying nominal levels of 94 to 127 or 187 to 253 volts rms (root mean square). These supply voltages are available throughout most of the world. The IEC-approved power line connector on the chassis of the 5000A will readily mate with a variety of power cables available locally to meet specific power connector pin configurations. A power cable is supplied for connection to grounded 115 volt power line receptacles.

1-3.2 Output Range

The frequency range of the 5000A is determined by the RF plug-in unit used. Each RF plug-in covers a single band with the operating frequency indicated on a slide rule dial accurate to within one percent of the dial reading.

A sweeping current power supply plug-in, Model 5222A, is also available for the 5000A. The output current, up to one Ampere, is indicated on the supplied dial scale.

1-3.3 Wide Sweep Capacity

Some RF plug-in units are available to cover extreme bandwidths. These units sweep over a range of several octaves in a single band.

1-3.4 Multiple Sweep Modes

Several operating modes are available: F1-F2 sweep mode, commonly called *wide* sweep mode, allows a frequency sweep to be started at any desired frequency within the range of the plug-in and terminated at any other such frequency. For narrow sweeps, Fc ± ΔF sweep mode (commonly called ΔF mode) allows the output of the plug-in to be swept or deviated symmetrically about a selected center frequency. The center frequency and deviation are calibrated functions. A non-swept (CW) output mode is also available, or the frequency may be controlled by a voltage source external to the 5000A.

1-3.5 Extended Sweep Rates

Sweep repetition rates of less than 10 milliseconds to over 100 seconds are available, as is manual sweep control.

1-3.6 Sweep Trigger Modes

Each frequency sweep may be initated internally at the end of the previous sweep, synchronized with power line frequency, initiated manually with a front-panel pushbutton, or initiated electrically with an external triggering signal.

1-3.7 Amplitude Modulation Modes

The output amplitude of the RF plug-in is controlled by switches on its own front panel to turn the output on and off at a one kilohertz rate, turn the output off only during sweep retrace time, reduce the output amplitude at marker points, or modulate the amplitude with the signal from an external leveler. An external amplitude control signal may be coupled through the rear-panel **EXT'L A.M.** jack directly to the RF plug-in.

1-3.8 Display Blanking Output

An output of plus 19 volts available during the sweep retrace period or while awaiting a sweep trigger signal may be used to eliminate the trace from the CRT display unit or X-Y recorder.

1-3.9 Optional Configurations

1-3.9.1 OPTION M1 NEGATIVE BLANKING. Model 5000A mainframes equipped with this option have a blanking output pulse with an amplitude of approximately minus 19 volts; the blanking pulse output of a standard 5000A is approximately plus 19 volts.

1-3.9.2 OPTION M3 POSITIVE TUNING REFERENCE. Model 5000AM3 has an adjustable output of zero to plus 10 volts (minimum) to zero to plus 35 volts (maximum) proportional to the RF output frequency of the plug-in. This output is used to drive some swept response analyzers and network analyzers such as the Hewlett-Packard 8410B and its accessories. The positive tuning reference output is in addition to the standard zero to plus 10 volt sweep output and the zero to minus 10 volt frequency volts output present in all 5000A's. Option M3 is not available in units equipped with Option M10.

1-3.9.3 OPTION M10 REMOTE CONNECTORS. Two multi-pin connectors added to the rear panel of the 5000A carry sweep, blanking, and marker output signals to a display unit and operating power to an accessory unit. The 5000AM10 is provided in many Systron-Donner test sets to reduce interconnection cabling between it and the Model 7000M1 Display Unit and to provide operating power for the Model 1206 IF Amplifier. Option M10 is not available in units equipped with Option M3.

1-3.9.4 OPTION M16 EXTENDED POWER LINE FREQUENCY RANGE. Model 5000A mainframes are normally supplied for operation from 50 or 60 Hertz power sources. Model 5000AM16 will operate from power line frequencies of 50 to 400 Hertz. (400 Hertz power lines are commonly found on aircraft and ships.)

1-4. ACCESSORIES

1-4.1 Accessories Supplied with 5000A

1-4.1.1 EXTENDER BOARD. Each 5000A is supplied with a printed circuit board extender assembly part number 950007. The extender, a servicing aid used with the other plug-in printed circuit assemblies, is stored inside the 5000A near the rear panel.

1-4.1.2 PHASE LOCK PLUG. One Model 9106 miniature phone plug is supplied with the 5000A; this plug mates with the rear-panel PHASE LOCK jack. The 9106 is supplied with a shorting wire in place but not soldered.

1-4.2 Optional Accessories

1-4.2.1 MODEL 9001 STORAGE CABINET. The storage cabinet holds four 5000-series RF plug-ins, keeping the plug-ins readily available and preventing loss of dial scales or damage to the plug-ins. When used with the Model 9004 rack-mounting kit (not included with 9001), the 5000A and 9001 bolt together to form a unit in 5¼ inches of standard 19-inch EIA rack space.

1-4.2.2 MODEL 9002 RACK ADAPTER CABINET. Model 9002 is a filler cabinet to allow mounting the half-rack width 5000A in a standard 19-inch EIA rack. No additional rack-mounting hardware is required; all necessary parts are included with the 9002.

1-4.2.3 MODEL 9004 RACK MOUNTING KIT. This kit contains the plates, handles, and all other hardware required for mounting the 5000A side-by-side with the 9001 Storage Cabinet or another half-rack instrument in 5¼ inches of rack space.

1-4.2.4 MODEL 9016 RACK MOUNTING KIT. This kit contains all hardware required to mount a 5000A Sweeper Mainframe and a Model 7000 Display Unit side-by-side in 5¼ inches of rack space.

1-4.2.5 MODEL 9107 PEN LIFT RELAY. In some cases, the plus 19 volt blanking output signal (minus 19 volts for 5000AM1) may not be the correct amplitude for blanking the sweep retrace. Many X-Y recorders require an external contact closure to drop or to lift the recording pen; the 9107 relay has single-pole, double-throw contacts rated for one Ampere at 115 volts ac (250 milliamperes at 24 volts dc) to serve this purpose when required.

1-4.2.6 MODEL 9041 TRANSIT CASE. Each pressure-molded fiberglass transit case will accommodate one Model 5000A with any plug-in; the handles are padded for easy carrying.

1-4.2.7 MODEL 9201 TEST PLUG-IN. This unit plugs into the 5000A in place of an RF plug-in, simulating the maximum power supply and heat load of a properly-operating plug-in. Each pin of the interface connector is brought out to a test point on the front panel of the 9201 to aid in calibration or troubleshooting of the 5000A.

1-4.2.8 MODEL 9202 EXTENDER. This unit fits between the 5000A and the plug-in unit to allow access to the calibration components and internal circuitry of the plug-in.

1-4.2.9 MODEL 9203 INVERTER. Used in conjunction with the 9202 Extender, this maintenance accessory allows physical inversion of the plug-in unit for easier testing or trouble isolation of the lower printed circuit assembly.

1-4.2.10 FLEXIBLE PLUG-IN EXTENSION. Any plug-in may be operated outside the 5000A mainframe using this 24-inch extension cable. Part number 109618 flexible extension is intended for trouble isolation and repair of plug-ins; it should not be used for final frequency or power level calibration because of voltage drops in the wires which carry high currents to the plug-in.

1-4.2.11 MODEL 9210 CALIBRATION DIAL. Recalibration of the frequency dial assembly may be necessary after parts replacement; in general, the dial scale supplied with an RF plug-in may be used for calibration of the 5000A. The 9210 calibration dial is recommended for facilities which have several 5000A's and several plug-ins of various ages and which need an absolute standard dial scale.

Table 1-1. Performance Specifications

ITEM	PARAMETER	SPECIFICATION
1	**Plug-in Compatibility**	
1.1	RF Plug-ins	All 5000-series RF plug-ins
1.2	RF Modules	All 525-series RF modules may be tested and calibrated with the 5000A using a 9202 Extender or 109618 flexible extension cable
1.3	Sweeping Current Supply Plug-ins	5222 and 5222A
1.4	Test Plug-in	9201
1.5	Extender Plug-in	9202
2	**Operating Modes**	
2.1	Wide F1—F2 Mode	Output frequency of RF plug-in is swept or manually scanned from limit set by **F1—START** control to limit set by **F2—STOP** control:
2.1.1	Band Coverage	100% of plug-in bandwidth
2.1.2	Sweep Direction	Up-band or down-band
2.1.3	Calibration Error	⩽ ±2%
2.2	CW Mode	Output frequency of RF plug-in is a discrete frequency set by **MARKER 2—Fc** control:
2.2.1	Band Coverage	100% of plug-in bandwidth
2.2.2	Calibration Error	⩽ ±2%
2.3	Fc ± ΔF x 1 Mode	Output frequency of RF plug-in is swept or manually scanned about a center frequency set by **MARKER 2—Fc** control:
2.3.1	Maximum Band Coverage	10% of plug-in bandwidth (**Fc ± ΔF VERNIER** set to **CALIB**)
2.3.2	Minimum Band Coverage	< 0.01% of plug-in bandwidth (**Fc ± ΔF VERNIER** set to **0**)
2.3.3	Sweep Direction	Up-band
2.3.4	Calibration Error	⩽ ±10% of indicated bandwidth
2.4	Fc ± ΔF x .1 Mode	Output frequency of RF plug-in is swept or manually scanned about a center frequency set by **MARKER 2—Fc** control:
2.4.1	Maximum Band Coverage	1% of plug-in bandwidth (**Fc ± ΔF VERNIER** set to **CALIB**)
2.4.2	Minimum Band Coverage	<0.01% of plug-in bandwidth (**Fc ± ΔF VERNIER** set to **0**)
2.4.3	Sweep Direction	Up-band
2.4.4	Calibration Error	⩽ 10% of indicated bandwidth

Table 1-1. Performance Specifications (Continued)

ITEM	PARAMETER	SPECIFICATION	
2	Operating Modes (Cont.)		
2.5	Fc ± ΔF x .01 Mode	Output frequency of RF plug-in is swept or manually scanned about a center frequency set by MARKER 2—Fc control:	
2.5.1	Maximum Band Coverage	0.1% of plug-in bandwidth (Fc ± ΔF VERNIER set to CALIB)	
2.5.2	Minimum Band Coverage	< 0.01% of plug-in bandwidth (Fc ± ΔF VERNIER set to 0)	
2.5.3	Sweep Direction	Up-band	
2.5.4	Calibration Error	≤ 10% of indicated bandwidth	
3	Frequency Range	Depends on RF plug-in used	
4	Frequency Accuracy	± 1% of indicated frequency at +25°C ambient and full rated RF output power of plug-in (worst-case combination of 5000A and RF plug-in specifications)	
5	Frequency Vernier		
5.1	Modes	Wide F1-F2, Fc ± ΔF, and CW	
5.2	Calibration	Calibrated in frequency as indicated by dial scale supplied with plug-in; vernier frequency adds to frequency shown by dial frequency indicators.	
5.3	Calibration Error	≤ ± 10% of indicated frequency	
6	Sweep Trigger		
6.1	Recurrent Mode	New sweep is automatically initated ≈ 3 ms after end of retrace	
6.2	Triggered Mode	Each sweep is initiated by the front-panel MANUAL pushbutton or by an external trigger pulse to the rear-panel EXT'L TRIG connector:	
6.2.1	Amplitude	≥ +3 V	
6.2.2	Pulse Width	≥ 1 μs	
6.2.3	Input Impedance	≈ 10 kΩ	
6.3	Line Trigger Mode	Start of each sweep is syncrhonized with positive peak of power line frequency	
7	Sweep Speeds	Vernier at X1	Vernier at X10
7.1	.01 Seconds		
7.1.1	Forward Trace	8.5—9.5 ms	94—104 ms
7.1.2	Retrace	0.8—1.2 ms	0.8—1.2 ms

Table 1-1. Performance Specifications (Continued)

ITEM	PARAMETER	SPECIFICATION	
7	Sweep Speeds (Cont.)	Vernier at X1	Vernier at X10
7.2	.1 Seconds		
7.2.1	Forward Trace	85—95 ms	940—1040 ms
7.2.2	Retrace	8—12 ms	8—12 ms
7.3	1 Second		
7.3.1	Forward Trace	0.85—0.95 s	9.4—10.4 s
7.3.2	Retrace	80—120 ms	80—120 ms
7.4	10 Seconds		
7.4.1	Forward Trace	8.5—9.5 s	94—104 s
7.4.2	Retrace	0.8—1.2 s	0.8—1.2 s
8	Manual Scan	Manually varies frequency between limits set in Wide F1—F2 Mode or Fc ± ΔF Mode	
9	External Sweep	External input voltage through **EXT'L SWEEP** connector adds to voltage determined by setting of **F1—START** control (Wide F1—F2 Mode) or **MARKER 2—Fc** control (CW and Fc ± ΔF Modes). **F2—STOP** control has no effect:	
9.1	Amplitude	0 to +10 V	
9.2	Input Impedance	≈ 25 kΩ	
9.3	Coupling	DC	
9.4	3 dB Bandwidth	10 kHz	
10	Sweep Output	Front and rear-panel **SWEEP OUTPUT** connectors	
10.1	Internal Sweep		
10.1.1	Modes	Wide F1—F2 and Fc ± ΔF	
10.1.2	Waveform	Linear ramp (sawtooth)	
10.1.3	Amplitude	0 V ±40 mV to +10 V ±40 mV	
10.1.4	Linearity Error	⩽ ±0.5% from straight line	
10.1.5	Output Impedance	< 100 Ω	
10.1.6	Current	10 mA max.	
10.2	Manual Scan		
10.2.1	Modes	Wide F1—F2 and Fc ± ΔF	
10.2.2	Waveform	Output voltage proportional to frequency	
10.2.3	Amplitude	0 V ±100 mV to +10 V ±100 mV	
10.2.4	Output Impedance	< 100 Ω	
10.2.5	Current	10 mA max.	

Table 1-1. Performance Specifications (Continued)

ITEM	PARAMETER	SPECIFICATION
10	**Sweep Output (Cont.)**	
10.3	External Sweep	
10.3.1	Modes	Wide F1—F2, Fc ± ΔF, and CW
10.3.2	Waveform	Identical to input signal
10.3.3	Amplitude	Identical to input signal
10.3.4	Output Impedance	Depends on input signal generator
10.3.5	Current	Depends on input signal generator
11	**RF Blanking**	+4.2 ±0.2 V during sweep retrace
12	**Blanking Output**	Rear-panel BLANKING OUTPUT connector
12.1	Internal Sweep, 5000A	Normally-supplied configuration
12.1.1	Modes	Wide F1—F2 and Fc ± ΔF
12.1.2	Waveform	Positive Pulse
12.1.3	Amplitude, Forward Sweep	≈ –600 mV
12.1.4	Amplitude, Sweep Retrace	+18 to +20 V
12.1.5	Pulse Period	Identical to sweep retrace period in recurrent sweep mode; refer to Item 7 of this table
12.1.6	Output Impedance	≈ 1 kΩ
12.2	Internal Sweep, 5000AM1	With negative blanking Option
12.2.1	Modes	Wide F1—F2 and Fc ± ΔF
12.2.2	Waveform	Negative pulse
12.2.3	Amplitude, Forward Sweep	≈ –200 mV
12.2.4	Amplitude, Sweep Retrace	–18 to –20 V
12.2.5	Pulse Period	Identical to sweep retrace period in recurrent sweep mode; refer to Item 7 of this table
12.2.6	Output Impedance	≈ 1 kΩ
12.3	Manual Scan	Blanking output fixed at ≈ –600 mVdc (5000A) or ≈ –200 mVdc (5000AM1)
12.4	External Sweep	Blanking output fixed at ≈ –600 mVdc (5000A) or ≈ –200 mVdc (5000AM1)
13	**Frequency Reference Output**	All 5000A configurations
13.1	Modes	All; rear-panel FREQ VOLT connector monitors frequency reference signal coupled to plug-in
13.2	Amplitudes	
13.2.1	Minimum	0 V
13.2.2	Maximum	–10 V
13.2.3	Lowest Usable Limit of Plug-in	–0.100 V
13.2.4	Highest Usable Limit of Plug-in	–9.900 V

Table 1-1. Performance Specifications (Continued)

ITEM	PARAMETER	SPECIFICATION
13	**Frequency Reference Output (Cont.)**	
13.2.5	24.5% of Rated Band	–2.585 V
13.2.6	50% of Rated Band	–5.000 V
13.2.7	74.5% of Rated Band	–7.415 V
13.3	Linearity Error	
13.3.1	5000A Only	⩽ ±0.5%
13.3.2	5000A and Plug-in	⩽ ±1%
13.4	Output Impedance	≈ 1 kΩ
14	**Positive Frequency Reference Output**	5000AM3
14.1	Modes	All
14.2	Amplitudes	Proportional to frequency of RF plug-in
14.2.1	Minimum	0 V
14.2.2	Maximum	Adjustable +10 to +35 V
14.3	Output Impedance	≈ 10 Ω
15	**Markers**	
15.1	Wide F1—F2 Mode	
15.1.1	Marker Coverage	100% of Band
15.1.2	Markers Available	Marker 1, Marker 2, and Marker 3
15.1.3	Marker Frequency Calibration	Direct-reading in frequency
15.1.4	Calibration Error	⩽ ±1%
15.2	Fc ± ΔF Mode	
15.2.1	Marker Coverage	±5% of Band
15.2.2	Markers Available	Marker 1 and Marker 3
15.2.3	Marker Frequency Calibration	Reading in frequency offset from Fc
15.2.4	Calibration Error	⩽ ±10%
15.3	Marker Output	Rear-panel **MARKER OUTPUT** connector
15.3.1	Waveform	Triangular pulse
15.3.2	Marker 1 Amplitude	⩾ –1.0 V peak
15.3.3	Marker 2 Amplitude	⩾ –1.2 V peak
15.3.4	Marker 3 Amplitude	⩾ –1.0 V peak
15.3.5	Output Impedance	≈ 3 kΩ

Table 1-1. Performance Specifications (Continued)

ITEM	PARAMETER	SPECIFICATION
16	**Quieting**	Output activates tuning-bandwidth rate limit circuitry in RF plug-in:
16.1	Modes	CW and Manual Scan
16.2	Amplitude	
16.2.1	CW Mode	+3 to +6.5 Vdc
16.2.2	Manual Scan Mode	+4 to +7 Vdc
18	**1 kHz Output**	Rear-panel **1 KHZ OUTPUT** connector carries 1 kHz output of RF plug-in; refer to RF plug-in manual for detailed specifications:
17.1	Waveform	Square Wave
17.2	Frequency	1000 Hz nominal
17.3	Adjustment Range	≥ ±50 Hz (set by RF plug-in)
17.4	Amplitude	≈ +2 V peak
17.5	Output Impedance	≈ 1 kΩ
18	**External Amplitude Modulation**	Rear-panel **EXT'L A.M.** connector couples external input directly to RF plug-in; refer to appropriate RF plug-in manual for specifications
19	**Phase Lock**	Rear-panel **PHASE LOCK** connector couples external input directly to RF plug-in; refer to appropriate RF plug-in manual for specifications
20	**Power Input**	
20.1	Voltages	104 V ±10% (93.6 to 114.4 Vac) 115 V ±10% (103.5 to 126.5 Vac) 208 V ±10% (187.2 to 228.8 Vac) 230 V ±10% (207 to 253 Vac)
20.2	Frequency	
20.2.1	5000A	47—63 Hz
20.2.2	5000AM16	50—400 Hz
20.3	Phase	1 ϕ
20.4	Power	≤ 90 VA
21	**Power Supplies**	
21.1	+30 V Output	
21.1.1	Tolerance	+30.0 Vdc ±100 mVdc
21.1.2	Current Limit	800 ±50 mA

Table 1-1. Performance Specifications (Continued)

ITEM	PARAMETER	SPECIFICATION
21	Power Supplies (Continued)	
21.1.3	Current Distribution	20 mA used in 5000A mainframe with 780 mA available for plug-in (a combined total of 1.0 A is available from the +30 V and +20 V outputs)
21.1.4	Load Regulation	⩽ 0.01% (±3 mVdc change for 0 to 600 mA load current)
21.1.5	Line Regulation	⩽ 0.01% (±3 mVdc change for ±10% change in line voltage)
21.1.6	Ripple @ 600 mA Load	⩽ 300 μV p-p, 1 Hz—30 kHz bandwidth
21.2	+20 V Output	
21.2.1	Tolerance	+20 Vdc ±20 mVdc
21.2.2	Current Limit	1.2 A ±100 mA
21.2.3	Current Distribution	200 mA used in 5000A mainframe, with 1.0 A available for plug-in (a combined total of 1.0 A is available from the +20 V and +30 V outputs)
21.2.4	Load Regulation	⩽ 0.01% (±2 mVdc change for 0 to 1.0 A load)
21.2.5	Line Regulation	⩽ 0.01% (±2 mVdc change for ±10% change in line voltage)
21.2.6	Ripple @ 1.0 A Load	⩽ 200 μV p-p, 1 Hz—30 kHz bandwidth
21.3	−20 V Output	
21.3.1	Tolerance	−20 Vdc ±20 mVdc
21.3.2	Current Limit	1.2 A ±100 mA
21.3.3	Current Distribution	200 mA used in 5000A mainframe with 1.0 A available for plug-in
21.3.4	Load Regulation	⩽ 0.01% (±2 mVdc change for 0 to 1.0 A load)
21.3.5	Line Regulation	⩽ 0.01% (±2 mVdc change for ±10% change in line voltage)
21.3.6	Ripple @ 1.0 A Load	⩽ 200 μV p-p, 1 Hz—30 kHz bandwidth
21.4	+250 V Output	
21.4.1	Tolerance	+250 Vdc ±25 Vdc (no load)
21.4.2	Current	40 mA available; output voltage decreases to ≈ 100 Vdc
21.4.3	Regulation	Unregulated
21.4.4	Ripple	⩽ 1 V p-p (no load)
22	Environment	
22.1	Operating Temperature	0 to +55°C (+32 to +131°F) ambient
22.2	Storage Temperature	−55 to +85°C (−67 to +185°F) ambient
22.3	Altitude	0 to 10,000 feet (3,05 km)

Table 1-1. Performance Specifications (Continued)

ITEM	PARAMETER	SPECIFICATION
23	Dimensions	
23.1	Height	5.25 in. (13,3 cm)
23.2	Width	8.50 in. (21,6 cm)
23.3	Total Depth	13.5 in. (34,3 cm)
23.4	Depth from Front Panel	11.75 in. (29,9 cm)
24	Weight (without plug-in)	≈ 15 lbs (6,8 kg)

SECTION II

INSTALLATION

2-1. UNPACKING AND INSPECTION

The 5000A is shipped in a specially constructed container to provide maximum protection during transit. Use care when unpacking to prevent damage to equipment such as cabinet finish, controls, connectors, etc.

2-1.1 Removing Contents

To remove the 5000A from the shipping container, cut and fold back outer carton top flaps, remove top protective cushion, lift instrument clear of shipping container, open dust protection bag and remove equipment.

2-1.2 Visual Inspection

The 5000A was carefully tested and inspected prior to shipment. Inspect the instrument for damage incurred during shipment. Check that the power cable is supplied with the test instrument. If the instrument is damaged in any way, notify the freight carrier immediately. Do not discard any packing materials, as the freight carrier's agent will wish to examine them.

2-1.3 Electrical Inspection

Conformance with operation and performance specifications may be verified by following the *performance check* procedures in Section V of this manual.

2-2. PREPARATION FOR USE

2-2.1 Normal Line Voltage Operation

The 5000A is shipped ready for use. Required power source is 115 or 230 volts rms (root mean square), single phase. The maximum allowable variation is plus or minus ten percent. The sweeper is normally shipped with the **115/230 V** switch in the **115 V** position. For operation from 230 volts, follow the directions below:

1. Be sure the power cord is disconnected.
2. With a small screwdriver, move the **115/230 V** switch on the rear panel to the **230 V** position.
3. Replace the 1 Ampere fuse with a ½ Ampere slow-blowing fuse (not supplied).
4. Connect the power cord between the **LINE** connector and power source.

2-2.2 Low Line Voltage Operation

The 5000A may be operated from power lines as low as 94 volts rms. To prepare a unit for operation from a 104 or 208 volt (plus or minus 10 percent) power line, follow the directions below:

1. Be sure the power cord is disconnected.

2. Remove the bottom cover of the 5000A

3. Locate power supply printed circuit assembly A7; jumper wires A7W1 are located near connector J20, below the power transformer (refer to Sheet of Figure 5- in Section V).

4. With a small (25 to 60 watt) soldering iron, remove one end of both jumper wires from both **115 V** terminals.

5. Move these jumper wire ends to the **104 V** terminals.

6. Replace the bottom cover.

7. If the unit is to be used with a 204 volt ac line, set the **115/230 V** switch to **115**; set the switch to **230** for use with a 208 volt line.

8. Check the fuse; use a 1 Ampere slow-blowing fuse for 104 volt operation, or a ½ Ampere fuse (not supplied) for 208 volt operation.

9. Connect the power cord between the **LINE** connector and power source.

2-2.3 Instrument Grounding

This sweeper is equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument for safety. The offset center pin of the rear panel three-prong **LINE** connector is the ground pin. It is recommended that the instrument be grounded to protect operating personnel. To preserve the protective feature of the instrument when operating from a two-contact outlet, use a two-prong adapter with the ground wire connected to a convenient ground point.

2-2.4 Manual Scan Quieting Disable

To reduce noise and increase stability of the RF output signal, the bandwidth of the oscillator tuning input in the RF plug-in is automatically reduced when the 5000A **MODE** switch is set to **CW** or when the **SWEEP SECONDS** switch is set to **MANUAL SCAN**.

Because the quieting circuit is activated in Manual Scan mode, the sweep start and stop frequencies set in Manual Scan will not correspond exactly with the start and stop frequencies while sweeping. If it is important that the start and stop frequencies be exactly calibrated, it is possible to modify the 5000A so that the quieting circuits will not be enabled when the **SWEEP SECONDS** switch is set to **MANUAL SCAN**.

After this modification has been incorporated, frequency shift between **MANUAL SCAN** and any of the other **SWEEP SECONDS** switch settings will be minimal.

1. Unplug the power cord.

2. Remove the top cover.

3. Locate printed circuit board A9. (Refer to Sheet 2 of Figure 5-3 in Section V.)

4. Locate Zener diode A9CR3 (1N5245) as shown in Figure 8-12 in Section VIII of this manual.

5. Clip either lead of the diode, or unsolder it from the circuit board.

6. Be sure that the loose lead from A9CR3 is not near or touching anything.

7. No calibration adjustments are required after these operations.

8. Replace the top cover.

2-2.5 Plug-in Unit Installation

To install a plug-in in the 5000A:

1. Be sure operating power has been turned off.

2. Remove the clear plastic dial scale from the bracket on the right side of the plug-in by loosening the two captive knurled knobs.

3. Insert the RF plug-in through the rectangular hole in the 5000A front panel.

4. Lock the plug-in in place by turning the small knob at the top of the plug-in clockwise.

5. Install the clear plastic dial plate in the large rectangular cutout at the top of the 5000A.

6. Simultaneously tighten both knurled screws by turning them clockwise until they are finger tight. Be sure the dial fits in the panel without binding.

2-3. MOUNTING

2-3.1 Bench Use

The sweeper is normally supplied with plastic feet and a fold-away tilt stand for convenient bench operation. The tilt stand permits raising the front of the instrument so that the frequency scale and control markings can be seen easily.

2-3.2 Rack Mounting

Several kits are available to rack mount the sweeper (refer to Paragraph 1-4.2). Necessary hardware is provided, including joining plates and corner brackets with handles. Instructions for rack mounting are provided with the selected hardware kit.

2-4. PACKAGING FOR SHIPMENT

If the instrument is to be packaged for shipment, use the original shipping container and packaging. If the original material has been discarded or is not in condition for re-use, perform the following packaging procedure:

1. Wrap the sweeper in a heavy wrapping or plastic protective covering.

2. Place a protective cushion in the bottom of the shipping carton and place the sweeper on the protective cushion.

3. Surround the remaining sides and top with additional protective cushions. Place front and rear protective cushions in such a manner as to provide support for the sweeper without resting it on controls or connectors.

2-5. SHIPPING METHOD

This sweeper should be shipped only by truck freight, rail freight, air freight, or parcel delivery service. If it is shipped by parcel post, damage is likely to occur. Systron-Donner is not responsible for units damaged in shipment to the factory for repair, whether such units are in-warranty or not.

2-6. INSURANCE

For your own protection, insure the sweeper for full value whenever it is shipped.

2-7. RETURNS FOR REPAIR

Be sure to fully identify any instrument that is returned to Systron-Donner or a Systron-Donner Service Center for repair of any kind, in-warranty or not. The paperwork with the unit must show the instrument serial number, a description of the problem or malfunction to be corrected, and the exact address to which the instrument should be returned when repair is completed. Please also include the *name* and *telephone number* of the cognizant party in your organization; this may speed the identification and repair of malfunctions.

SECTION III

OPERATING INSTRUCTIONS

3-1. SCOPE

This section contains descriptions of all operating controls and indicators, an initial operating procedure, and a summary of precautions for proper usage of the 5000A sweeper mainframe and a typical RF plug-in. Specific operating instructions for the various plug-ins used with the 5000A sweeper mainframe are contained in the manuals supplied with plug-ins.

3-2. FRONT PANEL CONTROLS AND INDICATORS

The front-panel controls, indicators, and connectors are illustrated in Figure 3-1, and are listed and described in Table 3-1.

3-3. REAR PANEL CONTROLS AND INDICATORS

The rear-panel controls and connectors are illustrated in Figure 3-2, and are listed and described in Table 3-2.

3-4. INITIAL OPERATING PROCEDURES

Figure 3-3 contains condensed initial operating procedures for the Model 5000A mainframe and a typical RF plug-in. These procedures are applicable to any swept measurement situation.

3-5. HINTS AND PRECAUTIONS

3-5.1 Changing Plug-ins

It is imperative that the 5000A mainframe power be turned off before removing or inserting a plug-in of any kind. Accidental misalignment of connector pins while the power is on can cause serious damage.

To protect external circuitry from possible damage, rotate the plug-in's **RF LEVEL** control fully counterclockwise before turning mainframe power on. Allow at least ten minutes' warmup time after power is turned on before making critical frequency measurements. Wideband swept measurements where frequencies do not have to be set to the worst-case mainframe and plug-in specification of plus and minus one percent may be made within a few seconds of turn-on.

CAUTION

WHEN A PLUG-IN EXTENSION CABLE OR RIGID EXTENDER IS USED, ALLOW AT LEAST TEN SECONDS TO ELAPSE AFTER POWER IS TURNED OFF BEFORE CONNECTING THE PLUG-IN UNIT. THIS PERIOD IS REQUIRED FOR THE CAPACITORS IN THE PLUS 250 VOLT POWER SUPPLY TO DISCHARGE.

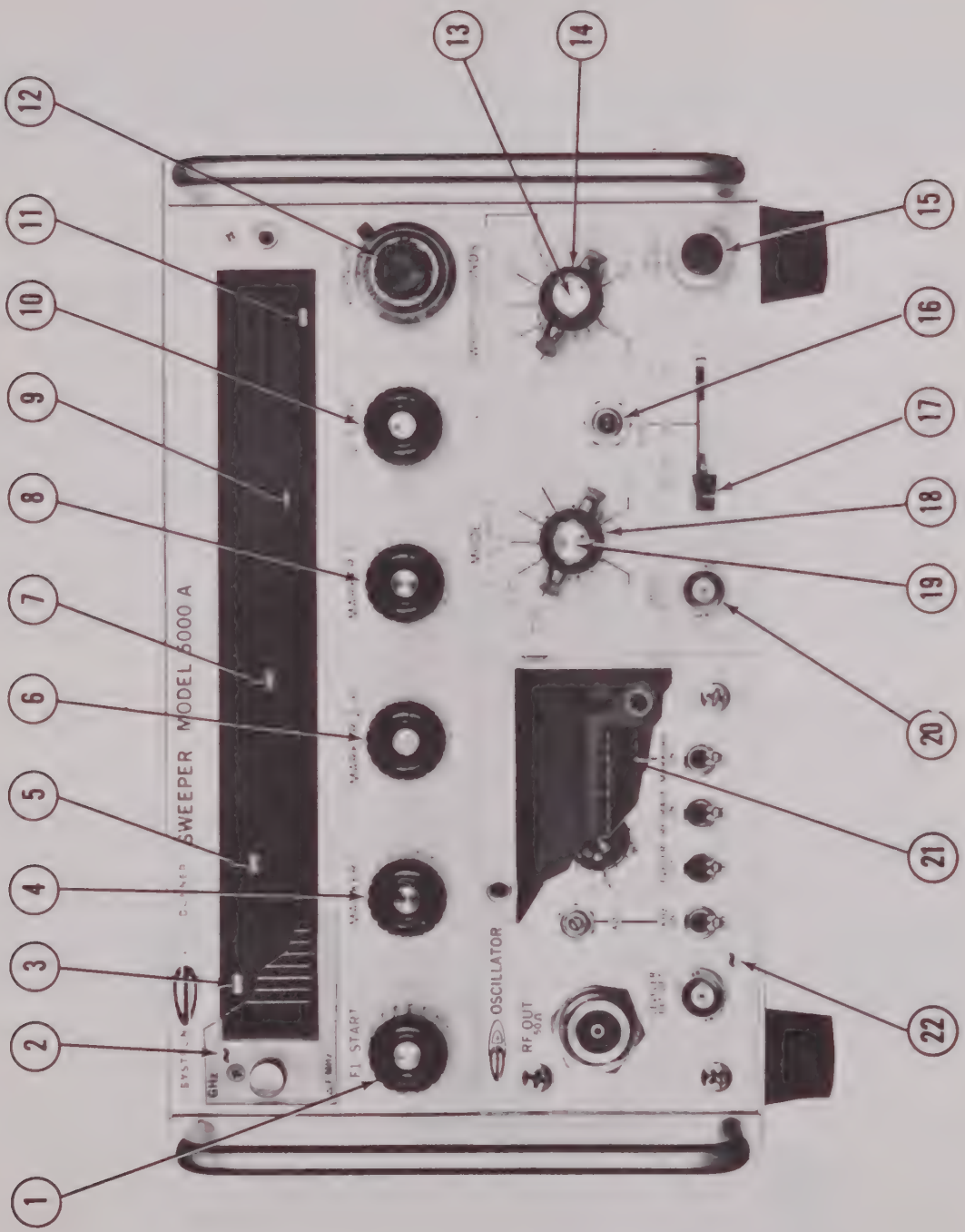


Figure 3-1. Front-Panel Controls and Indicators

Table 3-1. Front-Panel Controls and Indicators

INDEX NO. (FIG. 3-1)	FRONT PANEL NAME AND DESCRIPTION	FUNCTION
1	**F1–START** control	This control functions in Wide F1—F2 sweep mode to set the start frequency, as shown on the upper portion of the frequency scale by the gold indicator. The sweep start frequency may be set above or below the sweep stop frequency.
2	Dial Scale	Interchangeable plastic dial scale, supplied with each RF plug-in, has calibration markings for CW, wide sweep, and narrow sweep mode operating frequencies.
3	F1—Start Frequency Indicator	Gold indicator shows the selected F1—Start frequency in Wide F1—F2 sweep mode. The frequency is indicated on the upper part of the dial scale.
4	**MARKER 1** control	Sets the frequency of Marker 1 in Wide F1—F2 and Fc ± ΔF sweep modes.
5	Marker 1 Frequency Indicator	Green indicator shows the selected Marker 1 frequency on the upper part of the dial scale in Wide F1—F2 sweep mode or on the lower part of the dial scale in Fc ± ΔF sweep mode. The frequency indication in the latter mode is valid only when Item *19* is set to **CALIB**.
6	**MARKER 2–Fc** control	This control sets the frequency of Marker 2 (the marker of highest amplitude) when the **MODE** switch (Item *18*) is set to **WIDE F1–F2**. When the **MODE** switch is set to one of the Fc ± ΔF positions, the control establishes the center frequency (Fc) about which symmetrical sweep occurs. The same control sets the discrete frequency output when the **MODE** switch is set to **CW**.
7	Marker 2—Fc Frequency Indicator	Red indicator shows the selected Marker 2 frequency (Wide F1—F2 sweep mode), center frequency (Fc ± ΔF mode), or CW frequency. The frequencies are read on the upper part of the dial scale.
8	**MARKER 3** control	Sets the frequency of Marker 3 in Wide F1—F2 and Fc ± ΔF sweep modes.

Table 3-1. Front-Panel Controls and Indicators (Continued)

INDEX NO. (FIG. 3-1)	FRONT PANEL NAME AND DESCRIPTION	FUNCTION
9	Marker 3 Frequency Indicator	Blue indicator shows the selected Marker 3 frequency in Wide F1—F2 and Fc ± ΔF sweep modes (also refer to Item *19*).
10	**F2—STOP** control	Sets the frequency at which the frequency sweep ends in Wide F1—F2 sweep mode (only).
11	F2—Stop Frequency Indicator	Orange indicator shows the selected F2—Stop frequency in Wide F1—F2 sweep mode. The frequency is read on the upper part of the dial scale.
12	**VERNIER** control	Ten-turn potentiometer increases frequency of RF plug-in with CW rotation. Dial scale marking directly above **VERNIER** control gives full-scale frequency increase from zero to maximum.
	IMPORTANT **The dial frequency indicators for F1, F2, Fc, CW, and marker frequencies will not be calibrated when the VERNIER control is set to any position other than maximum CCW (0).**	
13	**VERNIER/MANUAL SCAN** control	This control allows the forward sweep rate in Wide F1—F2 and Fc ± ΔF sweep modes to be varied over a 10:1 range from the rate set by the **SWEEP SECONDS** switch. The period of sweep retrace is not affected by the setting of the **VERNIER/MANUAL SCAN** control. When the **SWEEP SECONDS** switch is set to **MANUAL SCAN**, the **VERNIER/MANUAL SCAN** control is used to set the output frequency of the RF plug-in to any point between the selected sweep start and sweep stop frequencies in Wide F1—F2 and Fc ± ΔF modes.
14	**SWEEP SECONDS** switch **.01**	This switch selects the period of the sweep ramp which controls the output frequency of the RF plug-in in Wide F1—F2 and Fc ± ΔF sweep modes: The forward sweep time is ≈ 9 ms (**VERNIER/MANUAL SCAN** at **x1**) to 100 ms (**VERNIER/MANUAL SCAN** at **x10**); sweep retrace time is ≈ 1 ms. This switch position produces flicker-free displays on oscilloscopes and CRT displays in **RECUR** and **LINE** trigger modes.

Table 3-1. Front-Panel Controls and Indicators (Continued)

INDEX NO. (FIG. 3-1)	FRONT PANEL NAME AND DESCRIPTION	FUNCTION
14 (Cont.)	**SWEEP SECONDS** switch (cont.)	
	.1	Sweep time is adjustable from ≈ 90 ms to ≈ 1 s, retrace time is ≈ 10 ms. This sweep speed is used mainly with oscilloscopes and CRT displays. *It is not recommended that line trigger mode be used; multiple triggering could occur at some settings of the* **VERNIER/MANUAL SCAN** *control.*
	1	Sweep time is adjustable from ≈ 900 ms to ≈ 10 s; retrace time is ≈ 100 ms. This sweep rate is appropriate for long-persistence CRT displays and X-Y recorders. *Do not use line triggering mode at this sweep speed.*
	10	Forward sweep time may be varied from ≈ 9 s with the **VERNIER/MANUAL SCAN** control at **x1** to ≈ 100 s at **x10**. The sweep retrace period is ≈ 1 s. This sweep speed is useful when X-Y displays, variable-persistence CRT displays, or digital-storage devices are employed. *Do not use line triggering.*
15	**PUSH ON–OFF** switch	Controls primary power to the 5000A; push to activate, push again to deactivate. The pushbutton lights red to indicate that power is on.
16	**MANUAL** pushbutton	A single press of the **MANUAL** pushbutton initiates the sweep when the **RECUR-TRIG-LINE** switch is set to **TRIG**. *If the* **MANUAL** *pushbutton is pressed before the end of sweep, a new sweep cycle will be initiated immediately without completion of the previous sweep.*
17	**RECUR-TRIG-LINE** switch	This lever switch selects the method of initiating (triggering) the start of each sweep:
	RECUR	The start of each sweep is initiated ≈ 3 ms after the end of the preceding sweep.
	TRIG	Sweep is initiated by pressing the **MANUAL** pushbutton or by an externally-applied signal (≥ 1 μs, ≥ +3 V peak) to the rear-panel **EXT'L TRIG** connector.

Table 3-1. Front-Panel Controls and Indicators (Continued)

INDEX NO. (FIG. 3-1)	FRONT PANEL NAME AND DESCRIPTION	FUNCTION
17 (Cont.)	RECUR-TRIG-LINE switch (Cont.)	
	LINE	The start of each sweep is synchronized with power line frequency. (This is *not* a line sweep mode.) *To avoid multiple triggering, line trigger mode should be used only at* .01 SWEEP SECONDS.
18	MODE switch	This switch selects the operating mode of the frequency-controlling circuits:
	WIDE F1–F2	Wide sweep mode (F1—Start, F2—Stop); the output frequency of the RF plug-in is varied between the frequencies indicated by the gold (start) and orange (stop) dial indicators on the upper portion of the dial scale. The output frequency may be swept or manually scanned either up-band or down-band. *The* F1–START *control is not operative in external sweep mode (see Table 3-2, Item 9).*
	CW	Single discrete frequency signal output of the plug-in is determined by the CW control and indicated by the red frequency indicator on the upper portion of the dial scale.
	Fc ± ΔF x 1	The output signal of the plug-in is swept symmetrically around a center frequency determined by the MARKER 2–Fc control and indicated on the upper part of the dial scale by the red indicator. The total deviation from Fc is + and – 5% of the bandwidth of the RF plug-in, as shown on the lower portion of the dial scale. *The ΔF sweep width as shown on the dial scale is calibrated only when the* Fc ± ΔF VERNIER *control is set to* CALIB.
	Fc ± ΔF x .1	The total deviation from Fc is + and – 0.5% of the plug-in bandwidth, and is indicated by dividing the lower dial scale markings by a factor of 10. *The dial markings are not valid unless* Fc ± ΔF VERNIER *is set to* CALIB.
	Fc ± ΔF x .01	The total deviation from Fc is + and – 0.05% of plug-in bandwidth; divide the lower dial scale markings by 100. Fc ± ΔF VERNIER *must be set to* CALIB *if the dial scale markings are to be used.*

Table 3-1. Front-Panel Controls and Indicators (Continued)

INDEX NO. (FIG. 3-1)	FRONT PANEL NAME AND DESCRIPTION	FUNCTION
19	**Fc ± ΔF VERNIER** control	Allows reduction of deviation from Fc in all Fc ± ΔF sweep modes from the calibrated maximum of ±5%, ±0.5%, or ±0.05% of plug-in bandwidth to ≈ zero deviation. *Frequency coverage of ΔF sweep and frequency calibration of markers 1 and 3 are calibrated only when this control is set to the* **CALIB** *position — fully CW with the switch actuated.*
20	**SWEEP OUTPUT** connector	This connector is in parallel with the **SWEEP OUTPUT** connector on the rear panel; the sweep ramp output drives the horizontal (sweep) input of an X-Y display in Wide F1—F2 or Fc ± ΔF sweep modes. In Manual Scan mode, the output is a 0 to +10 V level. There is no usable ramp output in CW mode. The output signal in External Sweep mode is identical to the external sweep input signal.
21	Interface Connector **WARNING** THIS CONNECTOR CARRIES LETHAL VOLTAGE.	24-pin female connector, inside plug-in compartment. Provides all power and signal connections between the 5000A mainframe and the plug-in.
22	Plug-in Unit	The actual generation of output signals is accomplished with an RF plug-in or sweeping current supply plug-in; this allows maximum versatility of the 5000A mainframe. Refer to the appropriate instruction manual for the plug-in used and to Figure 3-3 of this manual for plug-in operating instructions.

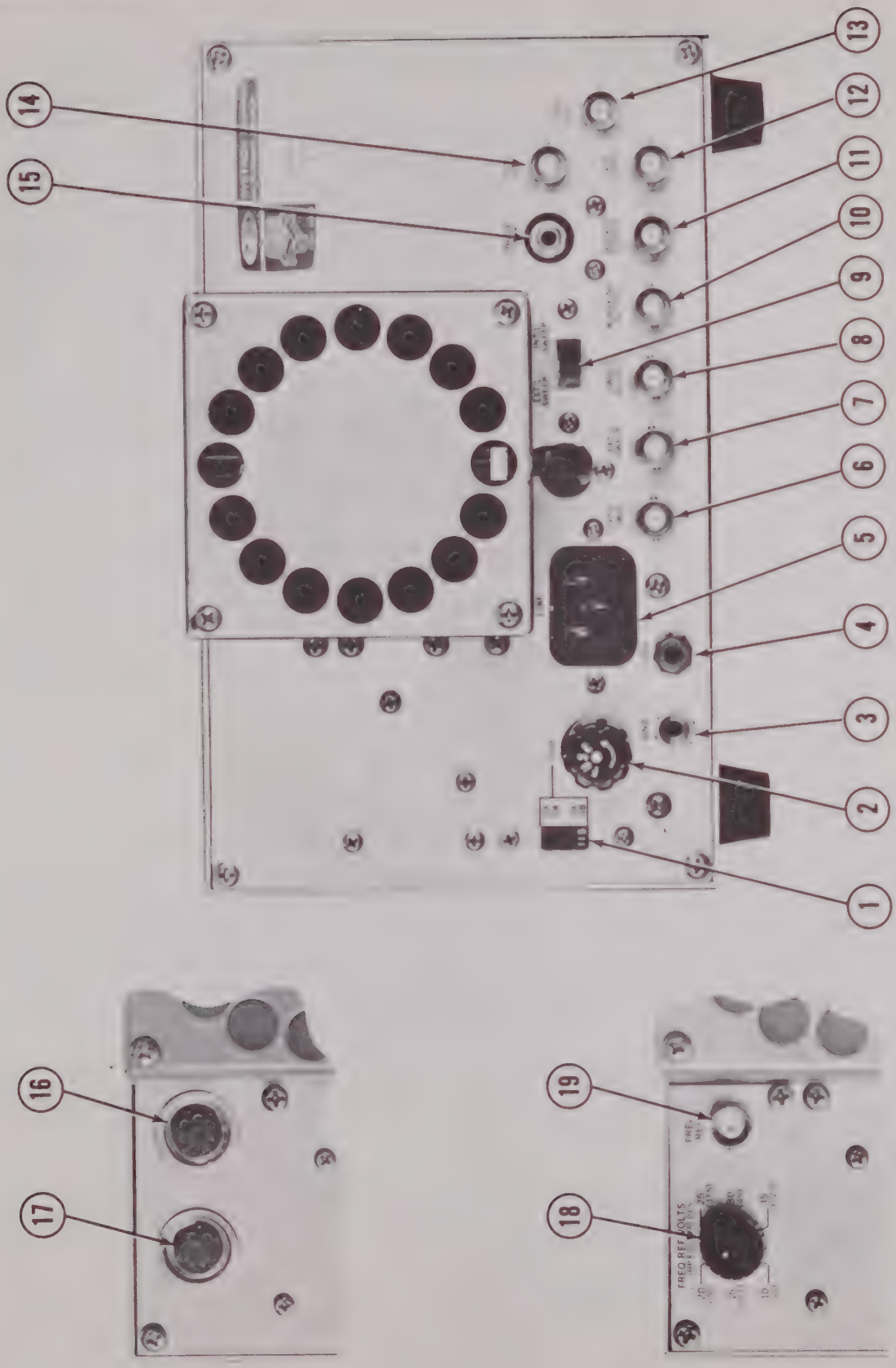


Figure 3-2. Rear-Panel Controls and Connectors

Table 3-1. Rear-Panel Controls and Connectors

INDEX NO. (FIG. 3-2)	REAR PANEL NAME AND DESCRIPTION	FUNCTION
1	**115/230 V** switch	Screwdriver-slot switch. Used to select 115 or 230 V power line operation (104 or 208 V when unit has been modified for low-voltage operation).
	CAUTION DO NOT MOVE THIS SWITCH WHEN THE LINE POWER CORD IS CONNECTED TO A POWER SOURCE.	
2	**FUSE** holder	Contains 1 A (115 V operation) or 0.5 A (230 V operation) slow-blowing instrument fuse.
3	**GND** terminal	Banana jack connects directly to chassis ground (power supply common) for grounding of equipment in a test setup or for use in conjunction with **+20 V** output (Item *4*).
4	**+20 V** terminal	Banana jack carries +20 ±0.01 Vdc for use as a source for external frequency-control or amplitude-control networks. *Digital circuitry or other transient-producing devices should not be powered from the* **+20 V** *terminal; noise introduced at this terminal could adversely affect the residual FM characteristics of the installed RF plug-in.*
	IMPORTANT This output is not current-limited. The operator should take care to allow circuitry connected to this output to draw no more than 10 mAdc.	
	CAUTION DO NOT SHORT-CIRCUIT THE +20 VOLT OUTPUT TO GROUND OR TO ANOTHER VOLTAGE SOURCE. DAMAGE TO THE 5000A MAINFRAME OR INSTALLED RF PLUG-IN UNIT COULD RESULT.	
5	**LINE** connector	Grounded 3-pin connector accepts input from power line through supplied or locally-available power cordset. *Late-production units employ an IEC (International Electrotechnical Commission) approved* **LINE** *connector conforming to worldwide safety standards.*

Table 3-2. Rear-Panel Controls and Connectors (Continued)

INDEX NO. (FIG. 3-2)	REAR PANEL NAME AND DESCRIPTION	FUNCTION
6	**EXT'L TRIG** connector	A pulse or level of ≥ +3 V, ≥ 1 μs, will initiate the start of sweep when the front-panel **RECUR-LINE-TRIGGER** switch is set to **TRIG.**
7	**EXT'L SWEEP** connector	Accepts external frequency-control input signal up to 10 V p-p when **EXT'L SWEEP/INT'L SWEEP** switch is set to **EXT'L SWEEP.** Positive polarity increases output frequency of RF plug-in. *Refer to Paragraph 3-5.6 for external sweep mode operating procedures.*
8	**SWEEP OUTPUT** connector	This connector is in parallel with the **SWEEP OUTPUT** connector on the front panel; the sweep ramp output drives the horizontal (sweep) input of an X-Y display in Wide F1—F2 or Fc ± ΔF sweep modes. In Manual Scan mode, the output is a 0 to +10 V level. There is no usable ramp output in CW mode.
9	**EXT'L SWEEP/INT'L SWEEP** switch **EXT'L SWEEP** **INT'L SWEEP**	Allows selection of the internal sweep ramp generator or an external generator as the source of frequency-control signals for the RF plug-in: Disables **F2—STOP** control and connects **SWEEP OUTPUT** connectors directly to **EXT'L SWEEP** connector; the **F1—START, VERNIER,** and all marker controls operate as in internal sweep mode. *Refer to Paragraph 3-5.6 for external sweep mode operating procedures.* Enables internal sweep ramp generator and configures 5000A for normal F1—F2, CW, or ΔF operation.
10	**BLANKING OUTPUT** connector	This connector carries +19 V during sweep retrace and trigger holdoff to blank the beam on Model 7000 Display Unit or other CRT displays (–19 V for 5000A Option M1).
11	**MARKER OUTPUT** connector	Output point for two triangular pulses ≈ –1 V in Fc ± ΔF mode at marker points set by front-panel **MARKER 1** and **MARKER 3** controls. An additional triangular pulse ≈ –1.2 V peak as set by **MARKER 2—Fc** control is available in Wide F1—F2 mode.

Table 3-2. Rear-Panel Controls and Connectors (Continued)

INDEX NO. (FIG. 3-2)	REAR PANEL NAME AND DESCRIPTION	FUNCTION
12	**1 KHZ OUTPUT** connector	Square-wave output of RF plug-in is brought to this connector without processing or modification in mainframe. The 1 kHz output may be fed to a frequency counter, used as a synchronizing signal for an oscilloscope or spectrum analyzer, etc. *Refer to Table 1-1.*
13	**FREQ VOLT** connector	The frequency-control voltage from the 5000A mainframe to the RF plug-in may be monitored at this connector. The voltage is proportional to output frequency, and is normally within the 0 to –10 V range. *The output voltage proportional to frequency does not include the effects of voltage introduced into the* **PHASE LOCK** *connector.*
14	**EXT'L A.M.** connector	Input point for external amplitude modulation or power control voltages; input signals are coupled directly to the RF plug-in without processing or modification by the 5000A mainframe. In general, the sensitivity is ≈ 100 mV/mW when the plug-in is operating in leveled mode. Positive-polarity inputs increase the output amplitude of the plug-in; negative inputs reduce the output amplitude. *Refer to the appropriate plug-in instruction manual for input signal specifications.*
15	**PHASE LOCK** connector	Input point for frequency-correction or FM signals; the signals are fed directly to the RF plug-in without processing or modification by the 5000A mainframe. *The input impedance and sensitivity vary widely among different models of RF plug-in; refer to appropriate plug-in instruction manual for phase lock signal specifications.*
16	**REMOTE 1206** connector	Seven-pin connector carries +20 V and –20 V power for operation of Model 1206 IF Amplifier or other device. *This connector is present only in 5000A mainframes ordered with Option M10.*
17	**REMOTE 7000** connector	Five-pin connector carries sweep output, blanking output, and marker output signals to Model 7000 Display Unit or other device. *This connector is supplied in Model 5000AM10 only.*

Table 3-2. Rear-Panel Controls and Connectors (Continued)

INDEX NO. (FIG. 3-2)	REAR PANEL NAME AND DESCRIPTION	FUNCTION
18	**FREQ REF VOLTS** control	Sets the maximum voltage output from a low of ≈ +10 to ≈ +35 V at the highest output frequency of the RF plug-in. The positive frequency reference output is specifically designed for use with network and swept response analyzers. *This control is present only in 5000A mainframes equipped with Option M3.*
19	**FREQ REF** connector	Output connector for positive frequency reference of 0 to an adjustable maximum of +10 to +35 V. *Present only in Model 5000AM3.*

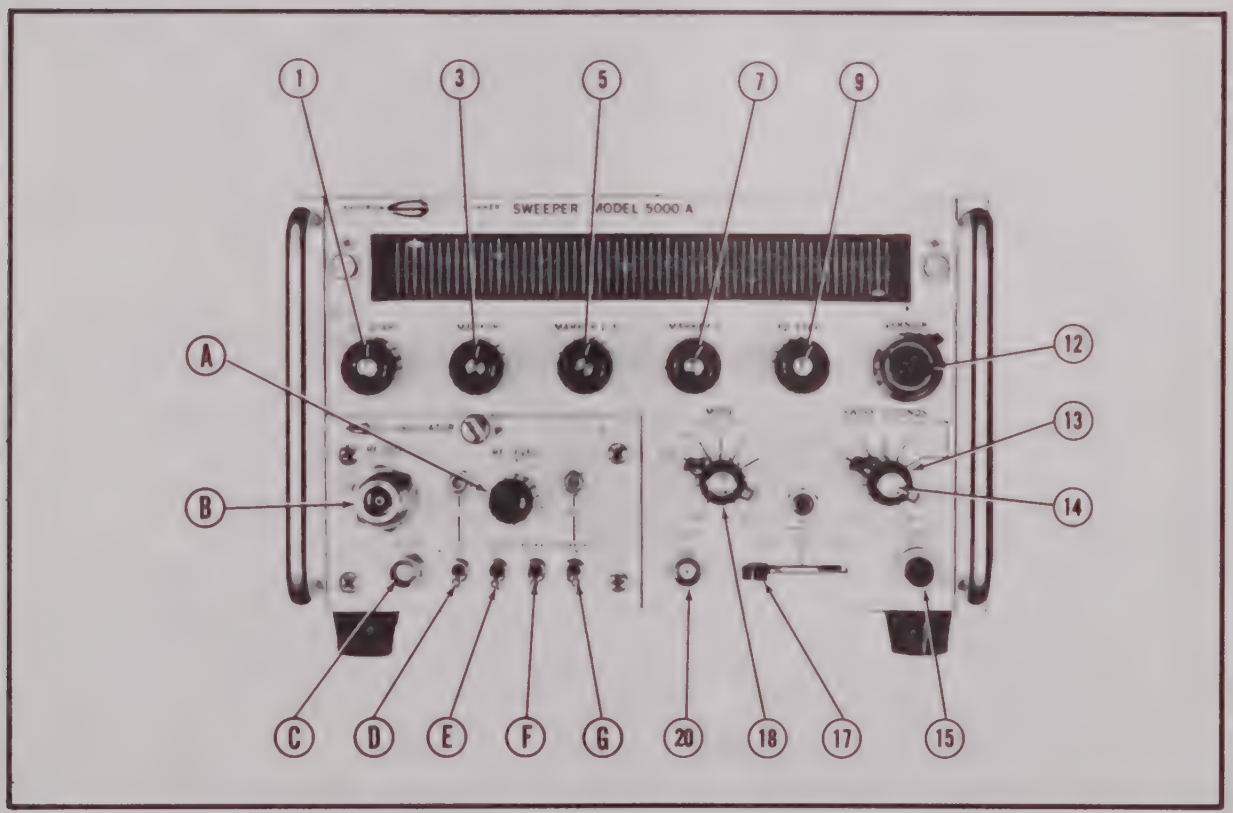


Figure 3-3. Initial Operating Procedures (Sheet 1 of 3)

A. PRELIMINARY CONTROL SETTINGS WITH RF PLUG-IN

Control	Setting
RF LEVEL (A)	Maximum CCW
PUSH ON-OFF (15)	Depressed to turn mainframe power on
INT'L SWEEP/EXT'L SWEEP	INT'L SWEEP (Rear panel)
SWEEP OUTPUT (20)	Connect to X-axis input of CRT display unit
RF OUT 50 Ω (B)	Connect suitable RF output cable to circuit or device to be sweep tested
MODE (18)	WIDE F1–F2
SWEEP SECONDS (13)	.1
SWEEP SECONDS VERNIER (14)	x1
TRIGGER (17)	RECUR
1 KHZ (D)	OFF
RETRACE (F)	OFF
MARKERS (G)	OFF

B. TYPICAL TEST METHOD WITH RF PLUG-IN

Control	Setting
F1–START (1)	Adjust so *GOLD* dial indicator is at lowest frequency of interest
F2–STOP (9)	Adjust so *ORANGE* dial indicator is at highest frequency of interest
LEVELER (E)	OFF
RF LEVEL (A)	Slowly increase the RF output of the plug-in while observing detected response of test item on display unit (oscilloscope or chart recorder).

Continue to increase the RF amplitude until the desired power level is reached. If an external leveler is used, connect its input to **LEVELER EXT DET** (C) and set the **LEVELER** switch (E) to **EXT**. Increase power until the output becomes unleveled as indicated on the display unit trace. Reduce setting of **RF LEVEL** control (A) as required.

If the shape of the swept response changes as a function of **SWEEP SECONDS VERNIER** (14) setting, reduce sweep speed until the distortion is no longer evident. This effect may be noticed when sweeping high-Q circuits, when the crystal detector output capacitor is of high value, or when logarithmic converters are used at the display unit input. In general, use the lowest sweep speed which allows comfortable viewing of the display unit trace with minimal distortion.

To use direct-reading frequency markers, set **MARKERS** switch (G) to **ON**.

Figure 3-3. Initial Operating Procedures (Sheet 2 of 3)

Adjust MARKER 2 (5) until the pip on the trace is over an area of interest in the swept response curve. The frequency of the discontinuity, anomaly, or other event is shown by the *RED* dial indicator. Adjust MARKER 1 (3) and MARKER 3 (7) to calibrate the swept response curve at points on either side of the frequency of interest. In many cases, it will be desirable to examine parts of the trace using narrow sweeps without disturbing the F1—F2 settings:

Control	Setting
MARKER 2—Fc (5)	Adjust so *RED* indicator is centered in the narrow band area of interest as read on upper part of frequency scale
MODE (18)	Fc ± ΔF x 1
MARKER 1 (3)	Set marker 1 so *GREEN* indicator shows lower calibration frequency on lower part of frequency scale
MARKER 3 (7)	Set marker 3 so *BLUE* indicator shows upper calibration frequency on upper part of frequency scale
Fc ± ΔF VERNIER (19)	Set to CALIB. When ΔF sweep width is reduced by rotating control CCW, Markers 1 and 3 become uncalibrated

C. OTHER CONTROLS

1. TRIGGER (17): Trigger modes other than recurrent have specific uses. In line trigger mode, the effects of power ground loops or power line-frequency noise in the displayed swept response curve can be minimized by synchronizing the sweep with these components. Manual mode is used for single sweeps or sweeps triggered on command when chart recorders or other plotting devices are used.

2. RETRACE (F): If a fast-rising pulse caused by turning off the RF output of the plug-in during retrace is causing distortion at the ends of the display unit trace, depress this pushbutton to leave RF on during retrace. This is also recommended if power meters are used in the system.

3. 1 KHZ (D): Use the 1 kHz square wave to amplitude-modulate the RF output for use with VSWR detectors or ratiometers.

4. VERNIER (12): For fine frequency adjustments in CW and narrow Fc ± ΔF sweeps; read frequency up to maximum indicated on dial scale which must be added to frequency indicated by the *RED* indicator on upper part of dial scale. VERNIER must be set to 0.0 (full ccw) to ensure accuracy of frequency readings.

Figure 3-3. Initial Operating Procedures (Sheet 3 of 3)

3-5.2 Power Supply Overloads

All power supplies in the 5000A are protected against overload or short circuit; this protection comprises foldback current limiting for the plus 30 volt, plus 20 volt, and minus 20 volt power supplies. The plus 250 volt supply is protected by the main power line fuse.

When an overload or short circuit occurs in any of the foldback-protected power supplies, the affected supply voltage will drop to zero; the other supplies may be affected as well. The power supply will *not* recover by itself; the main power line must be turned off by pressing the **PUSH ON-OFF** switch. Wait a minimum of 15 seconds before turning the power back on, or the affected power supply capacitors will not have fully discharged and the power supply will not recover. If the power supply does not recover after 15 full seconds with the power off, there is a malfunction in the 5000A or RF plug-in causing a permanent overload condition.

NOTE

Many RF plug-ins contain circuitry which will "crowbar" the power supply to protect the oscillator module in the plug-in. If this occurs often when the 5000A **MODE** switch is moved, or when the output frequency is at the high-frequency end of the band, the RF plug-in probably needs recalibration or repair.

3-5.3 Sweep Outputs

SWEEP OUTPUT connectors on the front and rear panels of the 5000A carry a sweep ramp of zero to plus 10 volts amplitude in Wide F1—F2 and Fc ± ΔF sweep modes; the period of the ramp is selected by the **SWEEP SECONDS** switch and the **VERNIER/MANUAL SCAN** control. This zero to plus 10 volt ramp is normally used to drive the X axis of a CRT display or chart recorder. Whenever **MANUAL SCAN** is selected, in either sweep mode, a level between zero and plus 10 volts (determined by the setting of the **VERNIER/MANUAL SCAN** control) is available.

The rear-panel **FREQ VOLTS** connector is a monitoring point for the frequency control voltage fed to the RF plug-in; when the **F1—START** control is set fully counterclockwise, the **F2—STOP** control is set fully clockwise, and the **MODE** switch is set to **WIDE F1—F2**, the sweep ramp is zero to minus 10 volts. Again, the period of the ramp is set by the **SWEEP SECONDS** switch and **VERNIER/MANUAL SCAN** control. The ramp varies with the frequency control settings, so that a narrow sweep up-band may be characterized by a minus 4 to minus 6 volt ramp; a wide sweep down-band (**F1—START** control clockwise, **F2—STOP** control counterclockwise) may be characterized by a minus 9 to minus 1 volt ramp. At any instant, the voltage output is proportional to frequency, in any sweep mode.

When one of the Fc ± ΔF settings of the **MODE** switch is selected, the ramp is swept symmetrically about a dc level determined by the setting of the **Fc** control; the voltage deviation is determined by the multiplier setting of the **MODE** switch and the position of the **Fc ± ΔF VERNIER** control.

If an external tuning voltage is used and selected with the **EXT'L SWEEP/INT'L SWEEP** switch, the **SWEEP OUTPUT** connectors carry the external input voltage or ramp.

3-5.4 Display Blanking

The ramp generator in the Model 5000A Sweeper Mainframe generates a blanking pulse during the retrace (flyback) portion of the sweep ramp in all triggering modes and during trigger holdoff time in externally or line-triggered modes. The period of the blanking pulse in recurrent triggering mode is one-tenth of the sweep rate; the amplitude is plus 18 to 20 volts (minus 18 to 20 volts for Model

5000AM1). The blanking pulse is available in Wide F1—F2 and Fc ± ΔF sweep modes. The blanking output is present in CW mode and while the ramp generator is awaiting a trigger signal in Line Trigger mode or External/Manual Trigger mode. No blanking pulse is generated during the three-millisecond start-of-sweep delay period in External Sweep mode, or in Manual Scan mode.

The Systron-Donner Model 7000 Display Unit is compatible with the blanking level available from the 5000A; set the 7000 rear-panel **BLANKING** switch to "–" to use the plus 18 volt blanking signal, or to "+" to use the minus 18 volt blanking signal. Some other CRT display units will not accept blanking signals of these levels and durations; general-purpose oscilloscopes generally couple Z-axis (intensity modulation) signals through a low-value, high-voltage capacitor to the CRT cathode. This type of circuit will not respond to a relatively low level (18 volt) pulse of one millisecond to one second in width.

If a differential-input oscilloscope is used as a display unit, the blanking output of the 5000A may be coupled into one input of the vertical amplifier, while the detected signal output is coupled to the other input. The retrace blanking signal will drive the CRT trace off-screen and out of sight. A dual-trace oscilloscope might be used if it has an *A + B* or *Added* mode.

3-5.5 Line Trigger Operation

When the **RECUR-TRIG-LINE** switch is set to **LINE**, the sweep ramp will be initiated approximately as the ac line voltage reaches the peak of its positive half-cycle. The *start* of each sweep is synchronized with the line frequency, but the *period* of each sweep is independently set by the controls. This mode is *not* a line sweep (sine wave sweep) mode as was used in most early and some contemporary sweepers of lower precision.

IMPORTANT

Line Trigger mode is not compatible with all sweep speeds; multiple triggering can occur at SWEEP SECONDS switch settings of .1, 1, and 10 and with some settings of the VERNIER/MANUAL SCAN control at the .01 SWEEP SECONDS setting. In these cases, the sweep ramp will retrace and forward sweep begin again before the previous sweep reaches its normal ten-volt peak.

3-5.6 External Sweep

External sweep mode may prove useful to the 5000A operator under several special circumstances:

1. A sweeper mainframe and RF plug-in used in an automated test system could be swept by the output of an electromechanical programmer or computer through a digital-to-analog conversion device

2. One 5000A sweeper mainframe could use the sweep ramp output of another 5000A (or another sweeper mainframe with a zero to plus ten volt ramp) for dual-channel or fixed-offset swept measurements

3. One or more 5000A sweeper mainframes could be driven by a master ramp generator to which other swept test equipment — network analyzers, spectrum analyzers, etc. — was also connected to achieve synchronous swept-signal generation and measurement capability

4. Where a linear ramp sweep waveform with fast retrace is not appropriate to the measurement situation and a sine-wave sweep, triangular sweep, logarithmic or exponential sweep, or some other relationship of output frequency versus time is desired.

External sweep signals to the 5000A replace the functions of the internal ramp generator, including the **VERNIER/MANUAL SCAN** control, and portions of the internal mode generator, including the **F2—STOP** control.

The rear-panel **+20 V** jack may be used as a voltage source for an external frequency-control potentiometer. A typical installation of this type will have the *CW* terminal of a 2,000-ohm potentiometer connected to the **+20 V** jack, the *CCW* terminal connected to the **GND** jack, and the *slider* (or *wiper*) terminal connected through a 25,000-ohm resistor to the **EXT'L SWEEP** jack. The potentiometer should be a precision ten-turn linear tapered unit with matching turns-counting dial. The fixed resistor should be a precision low-noise wirewound device with a tolerance of plus or minus one-half percent or better.

3.5.6.1 **EXTERNAL SWEEP BANDWIDTH.** The operator may select a wide tuning bandwidth of approximately 10 kilohertz for fast slew rate or high-amplitude external sweep inputs, or may select a limited bandwidth of approximately 10 Hertz for dc and other inputs with a low change rate. Setting the **SWEEP SECONDS** switch to any of the four sweep speed settings selects the wide bandwidth for an external sweep input. Setting the **SWEEP SECONDS** switch to **MANUAL SCAN** or the **MODE** switch to **CW** automatically selects the limited bandwidth by activating quieting circuits in the RF plug-in.

3-5.6.2 **EXTERNAL SWEEP OPERATING MODES.** In all cases, positive-polarity external sweep inputs cause the output frequency of the RF plug-in to increase; negative-polarity inputs cause the output frequency to decrease. (The polarities are with respect to chassis ground.)

When the **MODE** switch is set to **WIDE F1—F2**, a positive-going external sweep signals *adds to* the setting of the **F1—START** control; a negative-going input *subtracts from* the setting of the **F1—START** control. All three markers will operate normally as in internal sweep mode.

When the **MODE** switch is set to any of the three **Fc ± ΔF** settings, the external sweep input signal adds to (or subtracts from) the setting of the **MARKER 2—Fc** control. External sweep inputs which are ac-coupled or symmetrical about zero sweep the frequency of the RF plug-in symmetrically about the center frequency, Fc. Marker 1 and Marker 3 are available to the plug-in.

At the **CW** setting of the **MODE** switch, the external sweep input signal also adds to (or subtracts from) the setting of the **MARKER 2—Fc** control, or causes the plug-in output frequency to sweep symmetrically about Fc. Markers 1 and 3 are disabled in this mode; the tuning bandwidth limiting (quieting) circuits in the RF plug-in are enabled, reducing the tuning bandwidth to about ten Hertz.

3-5.6.3 **FREQUENCY CALIBRATION.** The frequency band covered by the RF plug-in is determined by the peak-to-peak value of the external sweep input signal; the minimum allowable voltage is zero, the maximum is plus ten volts. With the **F1—START** control and the **VERNIER** control both set to their counterclockwise limits, the output frequency of the plug-in is directly proportional to the input voltage. A ten-volt signal covers one hundred percent of the rated bandwidth of the plug-in; a five-volt signal covers one-half the rated bandwidth, and so on. The frequency calibration factor in kilohertz, megahertz, or gigahertz per volt may be calculated by subtracting the low-frequency limit of the plug-in from the high-frequency limit, then dividing the result by ten. The product of the voltage times frequency-per-volt figure, when added to the low-frequency limit of the plug-in, yields the output frequency for any external voltage input.

IMPORTANT

Do not exceed the specified voltage limits for the external sweep input. Some types of RF plug-in contain oscillator modules which will cause the power supplies of the 5000A to current-limit when driven beyond their usable band limits. A sufficiently high voltage *could* cause damage to the mainframe.

3-5.6.4 VERNIER. The VERNIER control operates in all modes, including all external sweep modes. The voltage introduced by the VERNIER control adds to the external sweep voltage, increasing the output frequency of the RF plug-in. The VERNIER control is usually left at 0 to eliminate confusion in external sweep mode.

3-5.6.5 PHASE LOCK. Any phase-lock input to the 5000A is coupled directly to the RF plug-in. The polarity of the phase-lock signal determines the direction of frequency change. As is the case when internal sweep mode is employed, the phase-lock signal is entirely separate from the frequency-control output of the 5000A and is not accounted for by frequency calibration markings or by output frequency versus frequency-control voltage calculations.

3-5.7 Sweep Frequency Limits

There will be measurement situations where the operator may wish to set the beginning and ending points of sweep more accurately than is possible with the use of the frequency dial scale and frequency indicators alone. The following techniques allow the sweep limits to be set to an accuracy of one-tenth percent rather than the specified worst-case accuracy of plus or minus one percent for the 5000A mainframe and a typical RF plug-in.

3-5.7.1 WIDE F1—F2 MODE. A frequency counter covering the range of interest is required to set the frequency limits to plus or minus one-tenth percent accuracy in Wide F1—F2 Sweep mode:

1. Allow the RF plug-in in the 5000A mainframe to stabilize (warm up) for at least 30 minutes.
2. Connect the output of the RF plug-in through a suitable attenuator and/or directional coupler to the input of the frequency counter.
3. Set the 5000A MODE switch to WIDE F1—F2.
4. Set the 5000A SWEEP SECONDS switch to MANUAL SCAN.
5. Rotate the VERNIER/MANUAL SCAN control fully counterclockwise.
6. Adjust the F1—START control to the desired start-of-sweep frequency as indicated on the frequency counter.
7. Rotate the VERNIER/MANUAL SCAN control fully clockwise.
8. Adjust the F2—STOP control to the desired end-of-sweep frequency as indicated on the frequency counter.
9. Repeat Steps *5* through *8* as many times as necessary to set the sweep limits to the desired accuracy.

10. Set the **SWEEP SECONDS** switch to the desired sweep rate.

IMPORTANT

The frequencies set in the steps above will tend to shift at faster sweep rates. Therefore, it is not useful to attempt to set the sweep limits closer than plus or minus one-tenth percent. Refer to Paragraph 3-5.7.3 in this section and Paragraph 2-2.4 in Section II for further information.

3-5.7.2 **Fc ± ΔF MODE.** A frequency counter covering the range of interest is required to set the frequency limits of the symmetrical sweep to plus or minus one-tenth percent accuracy in ΔF Sweep mode. This method is useful for setting narrow ΔF sweeps to calibrated limits when the switch-selected limits of plus or minus 5 percent, plus or minus 0.5 percent, and plus or minus 0.05 percent of the RF plug-in's bandwidth are not suitable:

1. Allow the RF plug-in in the 5000A mainframe to stabilize (warm up) for at least 30 minutes.

2. Connect the output of the RF plug-in through a suitable attenuator and/or directional coupler to the input of the frequency counter.

3. Set the **SWEEP SECONDS** switch to **MANUAL SCAN.**

4. Set the 5000A **MODE** switch to **ΔF x 1.**

5. Set the **VERNIER/MANUAL SCAN** control to the middle of its rotation, with the indicator dot on the knob pointing straight up.

6. Adjust the **MARKER 2—Fc** control until the frequency counter shows the desired center-of-sweep frequency.

7. Rotate the **VERNIER/MANUAL SCAN** control fully counterclockwise and note the frequency counter reading.

8. Rotate the **VERNIER/MANUAL SCAN** control fully clockwise and note the frequency counter reading.

9. Select the **MODE** switch setting (**ΔF x 1**, **ΔF x .1**, or **ΔF x .01**) which is most appropriate to the desired sweep rate.

10. Rotate the **Fc ± ΔF VERNIER** control fully counterclockwise to **0.**

11. Adjust the **MARKER 2—Fc** control to set the desired center-of-sweep frequency as indicated by the frequency counter.

12. Adjust the **Fc ± ΔF VERNIER** and **MARKER 2—Fc** controls to set the start-of-sweep and end-of-sweep frequencies while the **VERNIER/MANUAL SCAN** control is rotated from one end of its rotation to the other.

IMPORTANT

The ΔF sweep limits set in the steps above will tend to shift somewhat at faster sweep rates. Therefore, it is not useful to attempt to set the ΔF sweep limits closer than plus or minus one-tenth percent. Refer to Paragraph 3-5.7.3 in this section and Paragraph 2-2.4 in Section II for further information.

3-5.7.3 LIMITATIONS ON ACCURACY. Several factors contribute to the limitation of plus or minus one-tenth percent as the best practical accuracy achievable in a swept mode:

1. Slow Drift: Unless the frequency-control circuits in the 5000A mainframe, the frequency-control circuits in the RF plug-in, and the oscillator module itself achieve perfect thermal stability, there will always be a certain amount of frequency drift. Allowing the sweeper and plug-in to warm up for at least 30 minutes before making critical measurements will eliminate the majority of thermal drift errors, but changes in ambient air temperature and internal temperature changes (due to power supply dissipation, oscillator heating, etc.) continue to cause long-term instability which limits the ultimate accuracy of the output frequency.

2. Residual Frequency Modulation: Electromagnetic and/or electrostatic noise impulses conducted or radiated into the frequency-control circuits of the mainframe or plug-in, as well as the basic inaccuracies of the plug-in's oscillator module itself, contribute to short-term instability which prevents the output frequency of the RF plug-in from being absolutely identical from one sweep to the next.

3. Quieting Circuits: To reduce residual frequency modulation in non-swept modes, the bandwidth of the frequency-control circuits in the RF plug-in is reduced to approximately ten Hertz when the MODE switch is set to CW or when the SWEEP SECONDS switch is set to MANUAL SCAN. This factor leads to frequency errors when start and stop frequencies are set with a frequency counter in Manual Scan mode and the SWEEP SECONDS switch is then set to one of its other positions. A modification may be made to the 5000A which will reduce frequency errors from this cause; refer to Paragraph 2-2.4 in Section II.

4. Oscillator Modules: Oscillator modules used in 5000-series RF plug-ins are tuned to frequency by a voltage applied to a *varactor* or by the flux of an electromagnet surrounding a sphere of *YIG* material. The YIG oscillators in particular are affected by *hysteresis*, the property which causes the output frequency of the oscillator to vary depending upon the polarity direction of the tuning current.

   Both types of oscillator tend to shift frequency slightly as the sweeping speed is changed. To reduce the effect of this trait in precision measurements, chart recorders and other devices should be calibrated at the same sweep speed which is to be used for the measurement.

3-5.8 . Markers

The 5000A Sweeper Mainframe has an internal generator which produces an output pulse when the frequency-control voltage to the RF plug-in is coincident with a voltage set by one of the MARKER controls. Three variable frequency markers are available in Wide F1—F2 Sweep mode; two markers are available in Fc ± ΔF Sweep mode. Markers are present when the SWEEP SECONDS switch is set to MANUAL SCAN, but are disabled when the MODE switch is set to CW.

A variety of methods for adding frequency reference points to a swept response trace are available. Model 5000A includes a direct marker output fo the RF plug-in and a marker generator output which may be directly connected to the display unit used with the sweeper. Some of the methods used for adding markers to the swept frequency signal from a 5000A with its RF plug-in are detailed by category in the following paragraphs.

When used as part of a user-designed system, the sweeper mainframe and plug-in may be controlled by external frequency and amplitude inputs. The marker output pulses could be used in such a system to stop the external ramp generator, count and log the output frequency of the RF plug-in, then resume the sweep, continue to the next marker point and count that frequency. The complexity and configuration of such a system is optional with the user; Systron-Donner does not manufacture interface controllers of this type for the 5000A.

3-5.8.1 **DIRECT TRACE MARKING.** A grease pencil or similar device may be used to mark frequency reference points directly on the faceplate of a CRT display unit. Put the 5000A in CW or Manual Sweep mode, and use a frequency counter to set the reference points. This technique is usable in wide (F1—F2) or narrow (ΔF) sweeps.

3-5.8.2 **HETERODYNE MARKER (Figures 3-4 and 3-5).** A signal of known frequency can be combined with the swept signal to yield a heterodyne marker, sometimes known as a *birdie* marker. Figure 3-5 shows a typical setup (crystal-controlled markers could be used rather than the variable signal generator and frequency counter shown). Note that the directional coupler is connected *backwards* so it may be used to inject signals; a 20 or 30-decibel coupler is usually used to keep isolation between the marker and sweeper high.

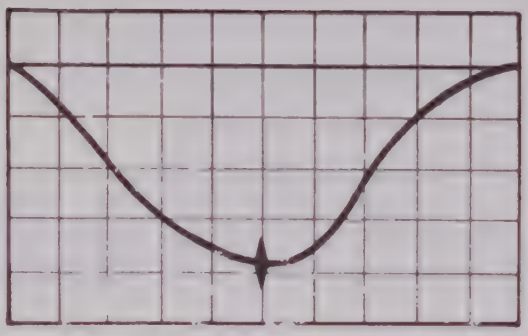
3-5.8.3 **COMB MARKERS (Figure 3-4).** A comb generator can be used to obtain multiple frequency markers if a single marker frequency is insufficient. A comb generator generally contains one, two, or three crystals and a harmonic generator. Such a unit might be used to add heterodyne markers at fixed intervals over the entire range of the swept output.

The setup shown in Figure 3-5 is applicable if a comb generator is used rather than the signal generator shown; the frequency counter and the second directional coupler are not needed.

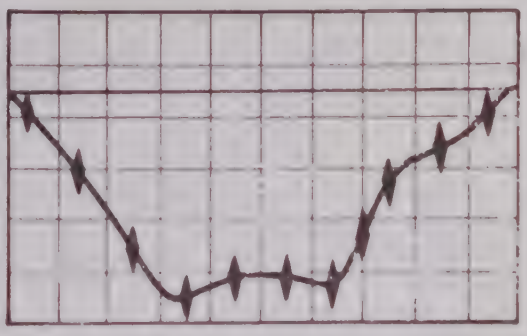
3-5.8.4 **CAVITY WAVEMETER (Figure 3-4).** A cavity wavemeter interposed between the output of the RF plug-in and the input of the detector will add an RF dip marker at a single frequency determined by the setting of the wavemeter. Cavity wavemeters commonly available cover 100 MHz to 18 GHz in overlapping ranges. The wavemeter is usually connected just ahead of the detector so that the momentary RF dip will not affect the unit being tested.

3-5.8.5 **RF DIP MARKERS (Figure 3-4).** All standard 5000-series RF plug-ins for the 5000A mainframe have the capability of producing RF dip markers. To use these markers, simply set the plug-in **MARKERS** switch to **ON**. The amplitude of the RF dip is controlled by the **MARKERS ADJ** potentiometer, also located on the front panel of the plug-in. Because the dip in amplitude is generated by a fast-rising pulse, and the pulsed RF passes through the circuit under test, this type of marker may not be the best choice at fast sweep speeds, in high-Q circuits, or in measurements where the detected RF signal is processed by a logarithmic amplifier (including Systron-Donner Model 7011 plug-in for Model 7000 Display Unit and Systron-Donner Models 4020, 4020A, and 4021 Digital RF Power Meters with logarithmic analog output).

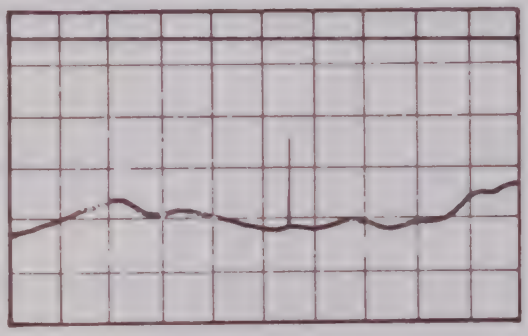
RF dip markers are best used when the RF plug-in is operating in leveled mode or in leveling-off mode at less than full power output. The markers will disappear when the plug-in operates in unleveled mode or in leveling-off mode at full power output.



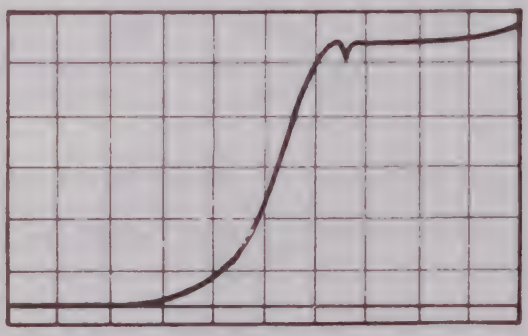
A HETERODYNE MARKER APPEARS WHEN THE OUTPUT FREQUENCY OF THE RF PLUG-IN IS COINCIDENT WITH THE FREQUENCY OF AN RF SIGNAL GENERATOR INJECTED BEFORE THE DETECTOR. THE PEAK OF THE MARKER *BIRDIE* IS THE MARKER POINT.



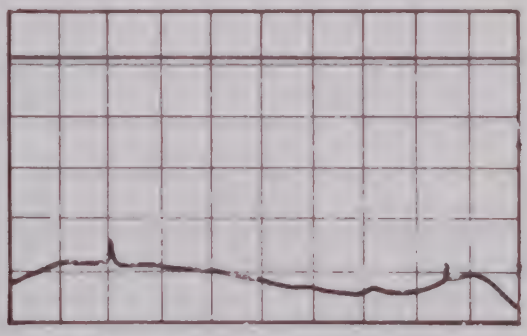
COMB MARKERS ARE FIXED-INTERVAL HETERODYNE FREQUENCY MARKERS GENERATED BY A PRECISION SOURCE AND HARMONIC GENERATOR. THE FREQUENCY INTERVAL BETWEEN ANY TWO ADJACENT MARKERS IS IDENTICAL, BUT THERE IS NO ABSOLUTE FREQUENCY CALIBRATION.



CAVITY WAVEMETERS ABSORB SOME OF THE RF OUTPUT OF THE PLUG-IN AT THE RESONANT FREQUENCY OF THE CAVITY. THE RESULTING RF DIP INDICATES THE MARKER FREQUENCY WHICH IS READ ON THE CALIBRATED DIAL OF THE WAVEMETER. THE DEPTH OF THE DIP IS NOT CONSTANT OVER THE FREQUENCY RANGE OF THE WAVEMETER OR THE AMPLITUDE RANGE OF THE PLUG-IN. THE DIP TENDS TO BE NARROWER AND SHARPER THAN RF DIP MARKERS GENERATED BY THE RF PLUG-IN.



RF DIP MARKERS ARE MOMENTARY REDUCTIONS IN RF AMPLITUDE; THEY VARY IN WIDTH ON THE CRT DISPLAY, BECAUSE THEY ARE GENERATED BY FIXED-WIDTH PULSES. THEY CAN BECOME QUITE WIDE OVER NARROW SWEEP WIDTHS.



RF DIP MARKERS ALSO TEND TO VARY IN HEIGHT, ESPECIALLY WHEN THE RF PLUG-IN IS OPERATED IN AN UNLEVELED MODE. FINALLY, RF DIP MARKERS TEND TO DISAPPEAR AT LOW AND HIGH POWER LEVELS, OR WHERE THERE IS A LARGE AMOUNT OF ATTENUATION IN THE SWEPT CIRCUIT.

Figure 3-4. Heterodyne and RF Dip Marker Characteristics

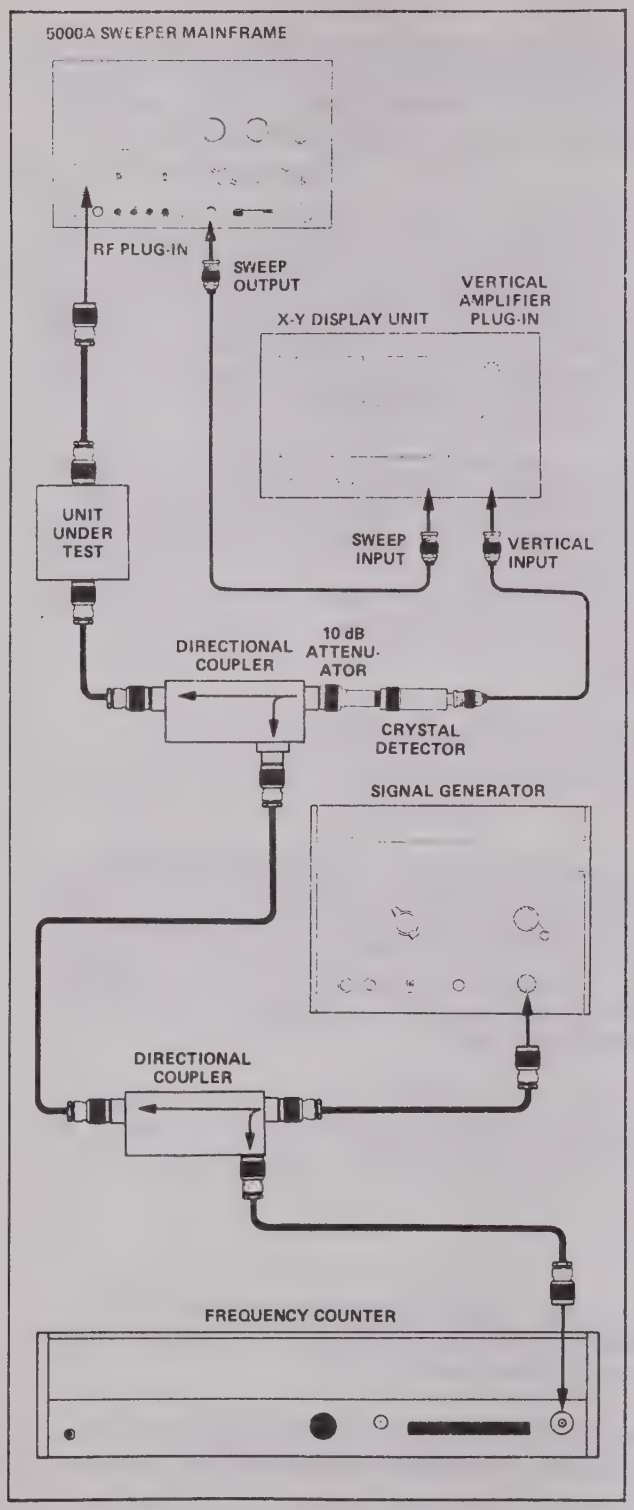
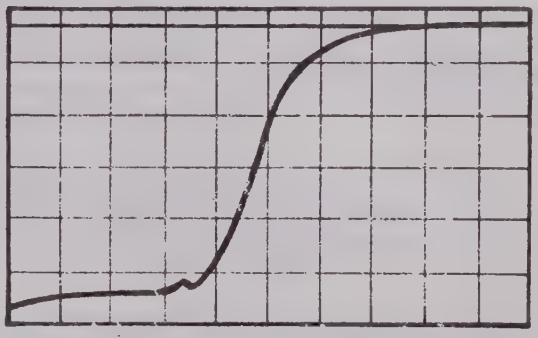
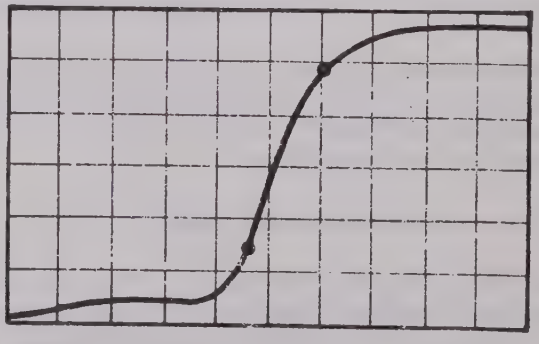


Figure 3-5. Typical Setup

VIDEO BYPASS MARKERS DO NOT VARY IN HEIGHT WITH RF AMPLITUDE, BUT REQUIRE A DIFFERENTIAL OR SUMMING INPUT AMPLIFIER IN THE CRT DISPLAY UNIT SO THAT THEY MAY BE ADDED TO THE SWEPT RESPONSE TRACE.



VIDEO BYPASS MARKERS ALSO TEND TO VARY IN WIDTH, JUST AS RF DIP MARKERS DO. ALTHOUGH THE HEIGHT OF THE MARKERS IS CONSTANT, THEY DO TEND TO DISAPPEAR ON TRACES WITH VERY STEEP SLOPES.



INTENSITY MARKERS DO NOT VARY IN WIDTH OR HEIGHT; THEY ARE BRIGHTENED DOTS. THE OVERALL TRACE INTENSITY MUST BE KEPT FAIRLY LOW, AND MANY OSCILLOSCOPES AND CRT DISPLAYS REQUIRE HIGH VOLTAGE PULSES FOR Z-AXIS MODULATION. AC-COUPLED Z-AXIS INPUTS WON'T FUNCTION WITH WIDE BLANKING PULSES.

Figure 3-6. Amplitude and Intensity Marker Characteristics

3-5.8.6 VIDEO BYPASS MARKERS (Figure 3-6). Video bypass markers produce dips on the detected RF signal which appear similar to RF dips. The advantage of video bypass markers is that the markers are not added to the swept response signal until after detection, and no marker signals are passed through the unit under test (fast-rising marker signals may cause undesirable ringing in otherwise properly-functioning circuits and devices).

To add video bypass markers to a conventional oscilloscope, connect a cable from the rear-panel MARKER OUTPUT connector of the 5000A to the second input channel of a differential oscilloscope preamplifier. A dual-trace oscilloscope preamplifier may be used rather than a differential amplifier if the preamplifier's *mode* control is set to *A + B*. If only a single input channel is available in the display unit, the marker output may be summed into the preamplifier input with a suitable series resistor. This latter technique may result in a slightly noisier oscilloscope trace, however, and could reduce the sensitivity of some crystal detectors which provide the primary input to the preamplifier.

Other X-Y display and recording devices, such as chart recorders and plotters, will accept marker inputs through their Y-axis preamplifiers in much the same manner as oscilloscopes. Because of the slower sweep speeds used with these devices, though, RF dip markers may usually be employed without disturbing the circuits under test. The Systron-Donner Model 7000 X-Y Display Unit accepts the marker output of the 5000A through its rear-panel VERTICAL IN connector to produce video bypass markers on the CRT trace.

NOTE

Model 7000M1 Display Units connected to Model 5000AM10 sweeper mainframes in integrated test sets use this type of marker input.

3-5.8.7 INTENSITY MARKERS (Figure 3-6). The marker pulses at the MARKER OUTPUT jack of the 5000A may be coupled into the intensity (Z) axis of a conventional oscilloscope or CRT display unit to produce brightened dots on the trace at marker points. Some oscilloscopes, including many older (vacuum-tube type) oscilloscopes, will not be driven to produce intensified dots by the marker output of the 5000A without external amplification and/or polarity reversal. The Z-axis performance specifications in the applicable oscilloscope instruction manual should be consulted to verify that a marker input of minus one volt peak is suitable to intensify the trace.

Systron-Donner Model 7000 Display Unit accepts the marker output of the 5000A through its rear-panel MARKERS connector when the MARKERS POLARITY switch is set to – (minus). The front-panel INTENSITY control of the 7000 should be adjusted for satisfactory trace brightness with discernable brightened dots.

3-5.9 Sweeping Current Supply

The 5000A Sweeper Mainframe will accept Current Supply Plug-in Model 5222 or Model 5222A in place of its normally-installed RF plug-in. The sweeping current supply formed by these two units is suitable for loads requiring ten milliamperes to one ampere, either polarity.

3-5.9.1 INSTALLATION. Prior to installation of the current supply plug-in, the internal current limit switch or wire jumper must be set to the *one ampere* position. The plug-in and dial scale are installed in the same manner as when RF plug-ins are used.

3-5.9.2 WIDE F1—F2 SWEEP MODE. The start-of-sweep current limit is set by the F1—START control and the end-of-sweep current is set by the F2—STOP control; output current may be swept in either direction. Output current polarity selection is switch-selected in the 5222A or manually selected

by reversal of the output leads in the earlier 5222. Any sweep speed may be used, including Manual Scan mode.

3-5.9.3 **CW MODE.** The current output of the plug-in is adjustable from ten milliamperes to one ampere with the **MARKER 2—Fc** control.

3-5.9.4 **Fc ± ΔF SWEEP MODE.** The output current is swept symmetrically about a current set by the **MARKER 2—Fc** control to a maximum of plus and minus 50 milliamperes (**ΔF x 1**), 5 milliamperes (**ΔF x .1**), or 500 microamperes (**ΔF x .01**). Any sweep speed may be used, including Manual Scan mode.

3-5.9.5 **VERNIER.** The **VERNIER** control functions in all modes, adding from zero to 100 milliamperes of output current to the values shown by the dial indicators.

3-5.9.6 **MARKERS.** Markers are not present in the current output of the plug-in, but the marker generator provides video bypass or intensity markers to an external display unit as if an RF plug-in were being used. Refer to Paragraph 3-5.8 for a description of marker functions.

3-5.9.7 **SWEEP TRIGGER.** Current sweep may be initiated recurrently, about three milliseconds after the end of the previous sweep (**RECUR**), manually or externally (**TRIG**), or in synchronization with the power line frequency (**LINE**). External sweep mode may be used if desired.

3-5.9.8 **BLANKING OUTPUT.** The output current of the plug-in is not blanked during sweep retrace, but the rear-panel **BLANKING OUTPUT** connector carries the normal plus 18 volt blanking pulse during sweep retrace time (minus 18 volts in 5000AM1). This output may be used to blank the display unit if desired (refer to Paragraph 3-5.4).

3-5.9.9 **REFERENCE OUTPUTS.** The rear-panel **FREQ VOLT** jack of the 5000A carries a voltage output proportional to the current output of the plug-in; the voltage to current ratio is linear from minus 100 millivolts (equivalent to 10 milliamperes) to 9.9 volts (equivalent to 1 Ampere).

The 5222A is equipped with a front-panel **MONITOR** connector which carries a proportional output voltage at a factor of one millivolt per milliampere.

SECTION IV

CIRCUIT DESCRIPTION

4-1. OVERALL FUNCTIONAL DESCRIPTION (Figure 4-1)

Figure 4-1 is a simplified block diagram of the Model 5000A Sweeper Mainframe with an RF plug-in installed.

Basically, the 5000A provides operating power and frequency-controlling signals to the RF plug-in which it houses. The 5000A and its plug-in comprise a swept frequency source, or sweeper (also swept frequency signal generator, sweep oscillator, etc.) which generates a predictable band of electromagnetic energy for instrument, system, or component testing. The sweeper replaces a single discrete-frequency generator where the speed and accuracy of a swept response are more desirable than the tedious point-by-point testing which would otherwise be required.

The sweepers used in RF testing operate in the frequency domain; the RF output amplitude of a device being tested is plotted against the frequency of operation. Generally, the RF is detected and presented as a dc level on the Y (vertical) axis of a cathode ray tube (CRT) display unit or chart recorder; a voltage proportional to frequency drives the X (horizontal) axis of the display unit.

There are other devices which could be classed as "sweepers": a semiconductor curve tracer plots voltage against current; the normal CRT oscilloscope plots voltage against time; and time domain reflectometers (TDR) plot reflected RF amplitude against time. Other frequency domain devices commonly in use include spectrum analyzers — swept receivers which display RF amplitude (Y) against frequency (X).

A complete frequency domain system can be assembled with a swept signal source, broadband detector, and X-Y display unit.

The RF plug-ins for the 5000A are tuned to their desired operating frequencies by a tuning (frequency reference) voltage in the range of zero to minus ten volts. This tuning voltage is generated within the 5000A mainframe or may be generated externally and coupled through the 5000A. The plug-ins and the frequency scales provided with them are calibrated so that a tuning voltage of minus 100 millivolts produces an RF output frequency equal to the first (lowest) marking on the frequency scale and a tuning voltage of minus 9.9 volts will provide an output frequency equivalent to the highest marked frequency.

The voltage to frequency relationship is linear over the operating range of the plug-in. As an example, consider an RF plug-in operating in the range of 12.4 to 18.0 gigahertz; the lowest frequency mark on the dial is 12,300 megahertz. The highest marked frequency is 18,100. The tuning factor of the plug-in is defined as follows:

$$T = (F_{max} - F_{min}) \div (V_{max} - V_{min}) \qquad (1)$$

Where:

T = the tuning factor in megahertz per volt
F_{max} = the highest marked frequency
F_{min} = the lowest marked frequency
V_{max} = the maximum usable tuning voltage output of the mainframe
V_{min} = the minimum usable tuning voltage output of the mainframe

The tuning voltage output range of the 5000A is zero to minus 10 volts and the usable frequency range of the RF plug-in is covered by the minus 0.1 to minus 9.9 volt portion, so Equation (1) reduces to:

$$T = (F_{max} - F_{min}) \div 9.8 \quad (2)$$

In the example cited:

$$T = (18{,}100 - 12{,}300) \div 9.8 \quad (3)$$

$$T = 592\ \text{MHz/V} \quad (4)$$

Therefore, an output frequency *change* (ΔF) of 592 megahertz will be effected by a tuning voltage *change* (ΔV_t) of exactly one volt. To determine the absolute output frequency effected by any given tuning voltage, simply add the product of the tuning voltage and the tuning factor to the lowest marked frequency:

$$F_o = [(V_t - 0.1)\,T] + F_{min} \quad (5)$$

Where:

V_t = the tuning voltage

F_o = the output frequency

In the example cited, a tuning voltage of minus five volts will produce an output frequency of 15.2 gigahertz:

$$F_o = [(5.0 - 0.1)\,592] + 12{,}300 = 2{,}901 + ,12{,}300 = 15{,}201 \quad (6)$$

4-1.1 Power Supplies

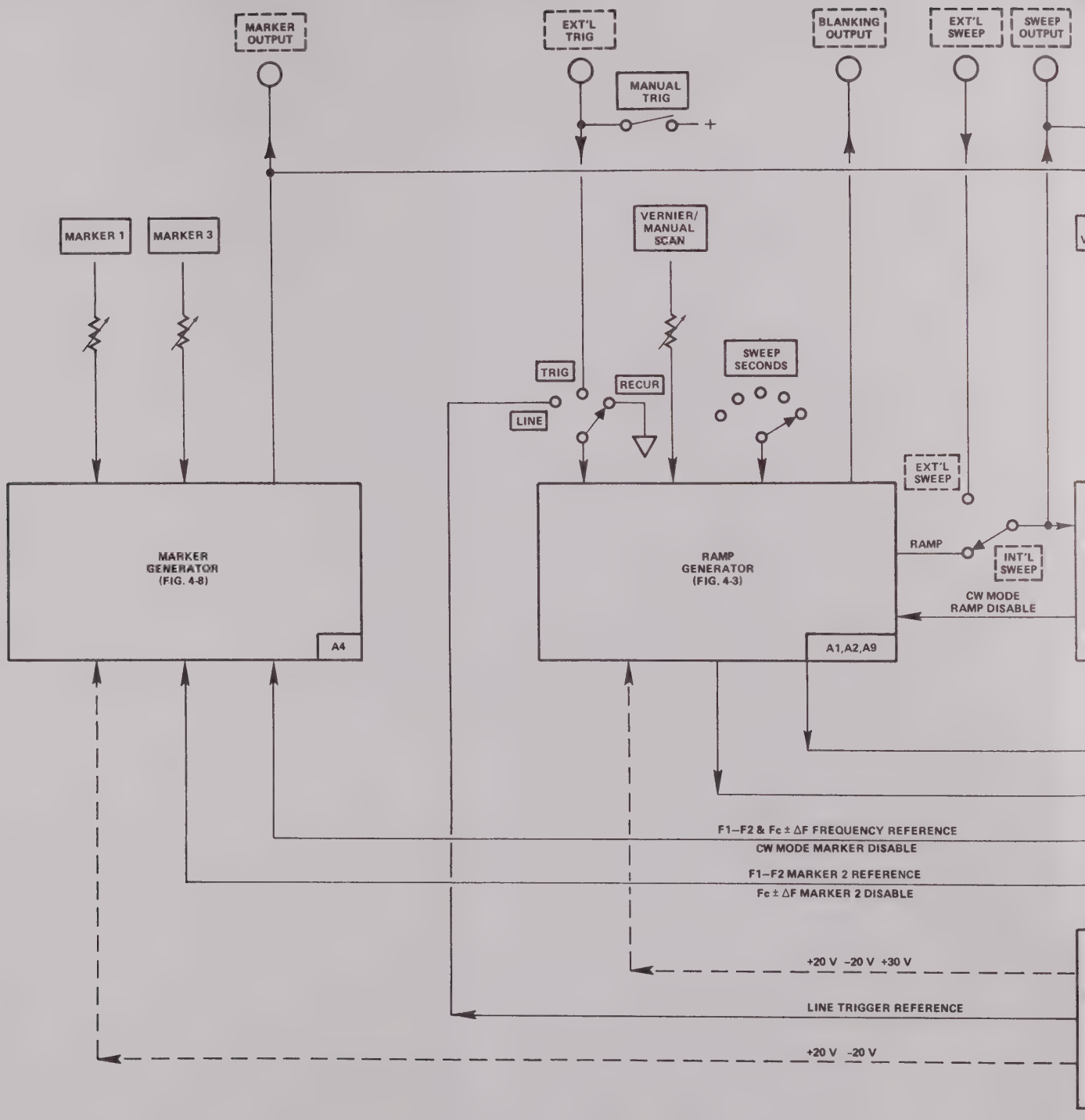
The power supply circuits convert alternating current line (mains) power to levels required by the 5000A and plug-in circuits; power supply outputs are plus 20 volts direct current (dc), minus 20 volts dc, plus 30 volts dc, and plus 250 volts dc unregulated. The power supply also furnishes a power line frequency reference signal to the ramp generator circuits.

The larger power supply components — the step-down transformer and electrolytic filter capacitors — are mounted on printed circuit assembly A7 with the rectifier diodes. The main power switch and pilot light, the primary fuse, the power line range switch, and the pass transistors for the regulated supplies are mounted to the chassis of the 5000A. Plug-in printed circuit assembly A5 contains the regulator circuitry for the plus 20 volt and minus 20 volt power supplies; plug-in printed circuit assembly A6 contains the regulator circuitry for the plus 30 volt supply. Printed circuit assembly A10, mounted to the rear panel, contains the current limiting resistors for the three regulated supplies.

Performance specifications for the power supplies are listed in Table 1-1, Section I.

4-1.2 Ramp Generator

The ramp generator produces a positive-going zero to plus ten volt linear ramp (sawtooth) signal when the sweeper is operating in Wide F1-F2 mode or in Fc ± ΔF mode. The period of this ramp is determined by the settings of the front-panel **SWEEP SECONDS** switch and the **VERNIER/MANUAL SCAN** control. The ramp generator is disabled when the **MODE** switch is set to **CW** or when the rear-panel **EXT'L SWEEP/INT'L SWEEP** switch is set to **EXT'L SWEEP**.


MARKER OUTPUT
EXT'L TRIG
MANUAL TRIG
+
BLANKING OUTPUT
EXT'L SWEEP
SWEEP OUTPUT
MARKER 1
MARKER 3
VERNIER/ MANUAL SCAN
SWEEP SECONDS
TRIG
RECUR
LINE
EXT'L SWEEP
RAMP
INT'L SWEEP
CW MODE RAMP DISABLE
MARKER GENERATOR (FIG. 4-8)
A4
RAMP GENERATOR (FIG. 4-3)
A1,A2,A9
F1–F2 & Fc ± ΔF FREQUENCY REFERENCE
CW MODE MARKER DISABLE
F1–F2 MARKER 2 REFERENCE
Fc ± ΔF MARKER 2 DISABLE
+20 V –20 V +30 V
LINE TRIGGER REFERENCE
+20 V –20 V

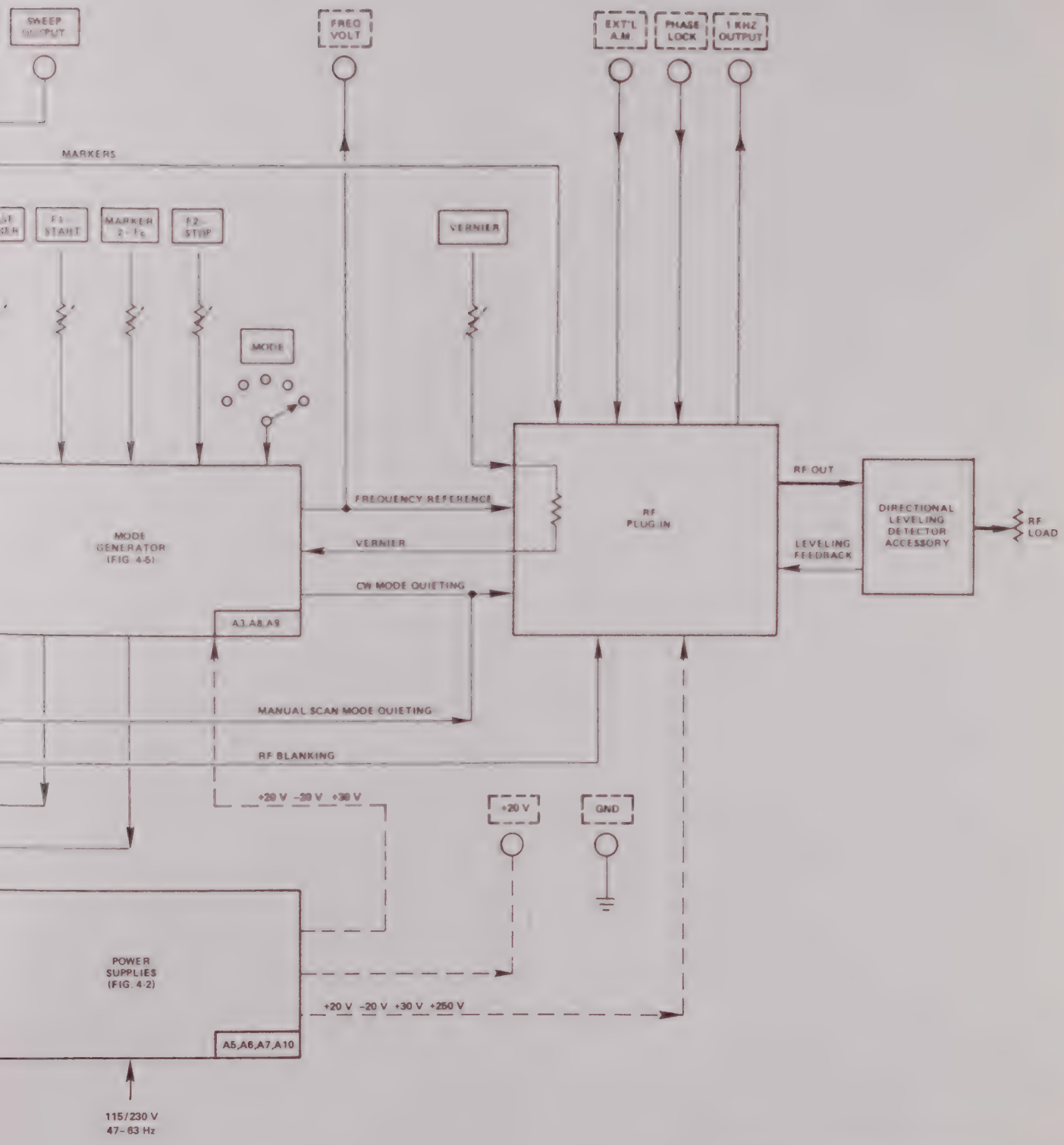


Figure 4-1. Model 5000A Functional Block Diagram

4-1.2.1 TRIGGER. The ramp may recur automatically, initiated by the power supply line trigger reference, triggered through the rear-panel **EXT'L TRIG** connector, or triggered manually with the front-panel **MANUAL** switch; the sweep triggering mode is selected by the **RECUR-TRIG-LINE** switch.

4-1.2.2 SWEEP OUTPUTS. The ramp signal is fed to the 5000A mode generator circuits and to the **SWEEP OUTPUT** connectors on the front and rear panels; these connectors provide the X (horizontal) axis signal for an external CRT display unit or X-Y plotter.

4-1.2.3 BLANKING. A blanking pulse is fed to the rear-panel **BLANKING OUTPUT** connector and to the RF plug-in. The blanking pulse is available during the sweep retrace period. The plus 19-volt blanking pulse (minus 19 volts when 5000A Option M1 has been supplied) is usually used to reduce the intensity of a CRT display unit or oscilloscope during sweep retrace. The blanking output may be used to activate the pen-lift mechanism in an X-Y recorder directly or through the Model 9107 Pen Lift Relay accessory.

The plus 19-volt blanking signal and a reduced blanking level are fed to the plug-in; the reduced level is about plus five volts. Most RF plug-ins use the signal to blank the RF output when the front-panel **RETRACE** switch is set to **OFF**.

4-1.2.4 MANUAL SCAN. When the **SWEEP SECONDS** switch is set to **MANUAL SCAN**, a zero to plus 10 volt level controlled by the **VERNIER/MANUAL SCAN** potentiometer is available in place of the zero to plus 10 volt ramp. This mode is available when sweeping in Wide F1-F2 mode or Fc ± ΔF mode, and is often used when it is necessary to set the sweep limits with an external frequency counter.

4-1.2.5 MANUAL SCAN QUIETING. A command from the sweep generator limits the tuning bandwidth of the oscillator driver circuits in the RF plug-in to approximately 10 Hertz when the **SWEEP SECONDS** switch is set to **MANUAL SCAN**; noise and residual FM are reduced in Manual Scan mode.

4-1.2.6 COMPONENT LOCATION. Major circuits and components which comprise the ramp generator include Timing Capacitor Assembly A1, Trigger-Sweep Assembly A2, Sweep Seconds Assembly A9, **SWEEP SECONDS** switch S3, **VERNIER/MANUAL SCAN** potentiometer R6, **RECUR-TRIG-LINE** switch S4, **MANUAL** switch S5, part of **EXT'L SWEEP/INT'L SWEEP** switch S6, and portions of **MODE** switch S7. Printed circuit assemblies A1 and A2 are plug-in boards, visible when the top cover of the 5000A is removed.

4-1.3 Mode Generator

The mode generator circuits process the zero to plus 10 volt output of the ramp generator or select a non-swept (CW) or externally-generated reference for the plug-in. The mode generator integrates all inputs from the front-panel frequency-control and frequency vernier potentiometers into a zero to minus 10 volt tuning reference for the plug-in.

4-1.3.1 WIDE F1—F2 MODE. The frequency reference to the RF plug-in in Wide F1-F2 mode is a zero to minus 10 volt ramp. This is not fixed as is the sweep generator output, but is varied by the **F1-START** and **F2-STOP** controls. Both the F1 (start) frequency and the F2 (stop) frequency may be set to any level between zero and minus 10 volts. When the **F1-START** control is set fully counterclockwise and the **F2-STOP** control is set fully clockwise, the RF output frequency sweeps from below the low frequency band limit to above the high frequency band limit. Narrower sweeps are achieved by moving the controls closer together. For example, a 4 to 8 gigahertz RF plug-in is swept from 3.9 to 8.1 gigahertz with a tuning input of minus 0.100 to minus 9.900 volts; if the tuning input ramp is changed to a minus 2.6 to minus 7.4 volt ramp, the RF output frequency of the plug-in would sweep from approximately 5 to 7 gigahertz. By setting the **F1-START** control to a higher negative voltage level than that to which the **F2-STOP** control is set, the output will sweep from a higher to a lower frequency.

4-1.3.2 CW MODE. When the front-panel MODE switch is set to CW, the tuning reference output of the mode generator is a discrete voltage between zero and minus 10 volts, set by the MARKER 2–Fc control. The resulting output of the RF plug-in is a non-swept single frequency.

4-1.3.3 Fc ± ΔF MODE. When the Fc ± ΔF mode is selected, the mode generator output is a plus and minus one-half volt maximum, negative-going ramp (exact amplitude set by the combination of the MODE switch setting and Fc ± ΔF VERNIER control) swept around a dc voltage (zero to minus 10 volts) set by the MARKER 2–Fc control.

4-1.3.4 CW QUIETING. A command from the mode generator limits the tuning bandwidth of the oscillator driver circuits in the RF plug-in when the CW mode has been selected, contributing to the low noise and residual FM figures in this mode.

4-1.3.5 COMPONENT LOCATION. Major circuits and components which make up the mode generator include Operational Amplifier Assembly A3, Dual Operational Amplifier Assembly A8, parts of Sweep Seconds Assembly A9 and EXT'L SWEEP/INT'L SWEEP switch S6, MODE switch S7, Fc ± ΔF VERNIER potentiometer R18, CALIB switch S8, VERNIER potentiometer R30, and the front-panel frequency-control potentiometers: F1–START (R25), F2–STOP (R12), and MARKER 2–Fc (R26, which functions as a frequency-control potentiometer in CW and Fc ± ΔF modes). Printed circuit assemblies A3 and A8 are plug-in boards.

4-1.4 Marker Generator

The marker generator produces a negative-going triangular pulse whenever the frequency reference voltage coupled to the RF plug-in is coincident with direct-current levels set by the marker controls. As the sweep ramp voltage increases or decreases during sweep, the voltage comparators in the marker generator will sense coincidence with the opposite polarity levels set by the operator. Three markers are available in Wide F1-F2 sweep mode; two markers are available in Fc ± ΔF sweep mode. The marker circuits are biased off in CW mode.

Marker pulses are coupled to the RF plug-in and to the rear-panel MARKER OUTPUT connector.

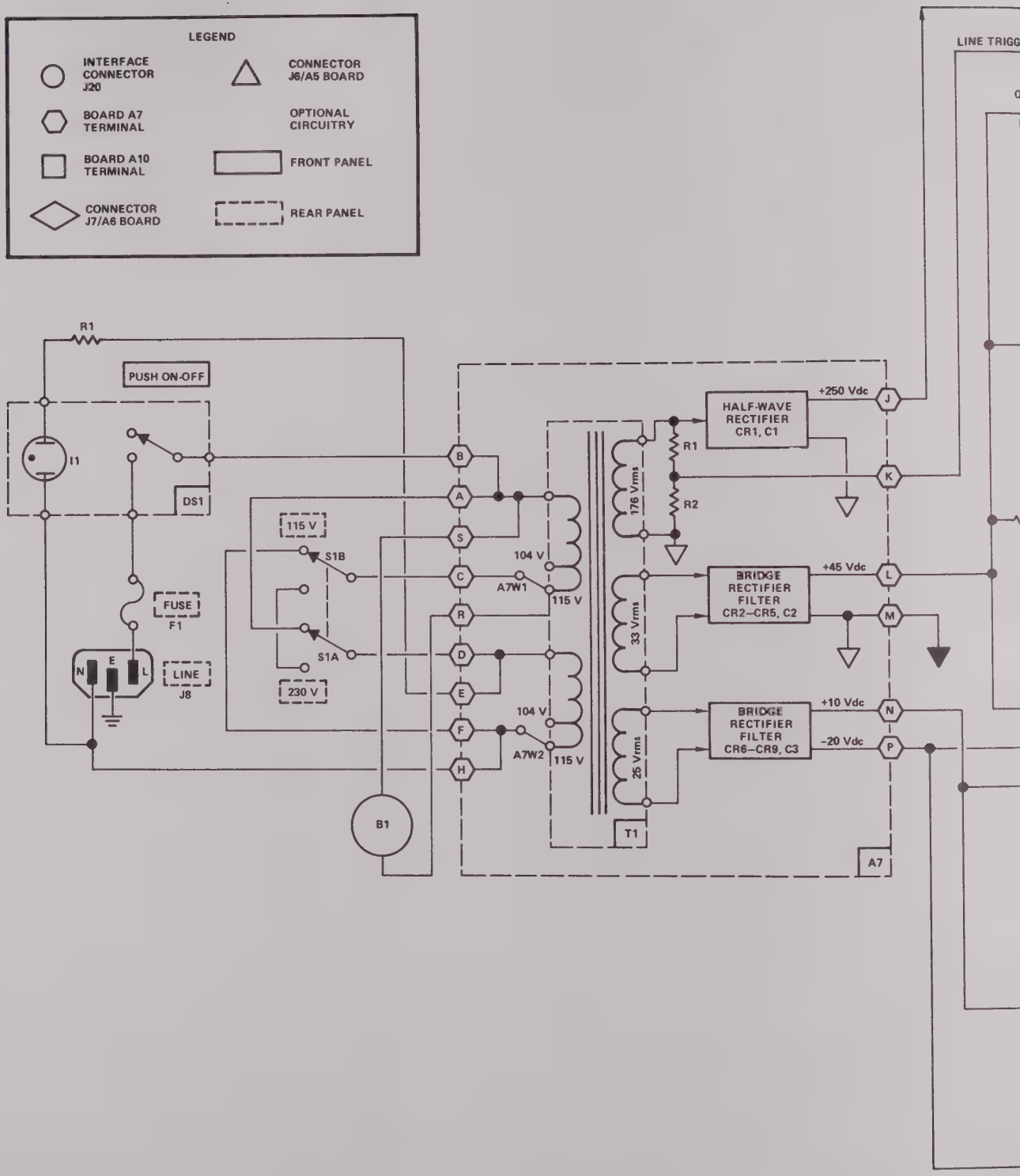
Plug-in Triple Marker Generator assembly A4, portions of MODE switch S7, and the front-panel marker potentiometers comprise the marker generator circuits; these potentiometers are MARKER 1 (R14), MARKER 2–Fc (R26), and MARKER 3 (R16).

4-2. DETAILED FUNCTIONAL DESCRIPTIONS

As an aid to understanding the circuitry of the Model 5000A Sweeper, a separate simplified schematic diagram has been prepared for each functional area shown in block diagram Figure 4-1. The major functional elements of the Model 5000A are the power supplies, ramp generator, mode generator, and marker generator. The figure number of the detailed block diagram or simplified schematic diagram or diagrams showing each of these elements is shown in Figure 4-1. The succeeding subparagraphs provide detailed descriptions for each of the major functional elements. The location (reference designation) of each significant element is indicated on the detailed block or simplified schematic diagram.

4-2.1 Power Supplies (Figure 4-2)

4-2.1.1 INPUT CONDITIONING. Operating power from the 50 to 60 Hertz line is brought in through rear-panel LINE connector J8 and controlled by PUSH ON-OFF switch DS1. Switch S1 on the rear panel connects the split primary windings of transformer A7T1 in parallel for operation from a 115-volt line or in series for operation from a 230-volt line. The transformer primary windings are tapped to allow operation from lower-than-normal power line voltages; jumper wires A7W1 and A7W2 on terminal board A7 are factory-set for normal line voltage operation, but may be changed in the field.


LEGEND
INTERFACE CONNECTOR J20
CONNECTOR J6/A5 BOARD
BOARD A7 TERMINAL
OPTIONAL CIRCUITRY
BOARD A10 TERMINAL
FRONT PANEL
CONNECTOR J7/A6 BOARD
REAR PANEL
LINE TRIGG
R1
PUSH ON-OFF
I1
DS1
FUSE F1
N
E
L
LINE J8
115 V
S1B
S1A
230 V
B
A
S
C
R
D
E
F
H
104 V
A7W1
115 V
104 V
A7W2
115 V
B1
176 Vrms
33 Vrms
25 Vrms
R1
R2
HALF-WAVE RECTIFIER CR1, C1
+250 Vdc
BRIDGE RECTIFIER FILTER CR2–CR5, C2
+45 Vdc
BRIDGE RECTIFIER FILTER CR6–CR9, C3
+10 Vdc
–20 Vdc
J
K
L
M
N
P
T1
A7

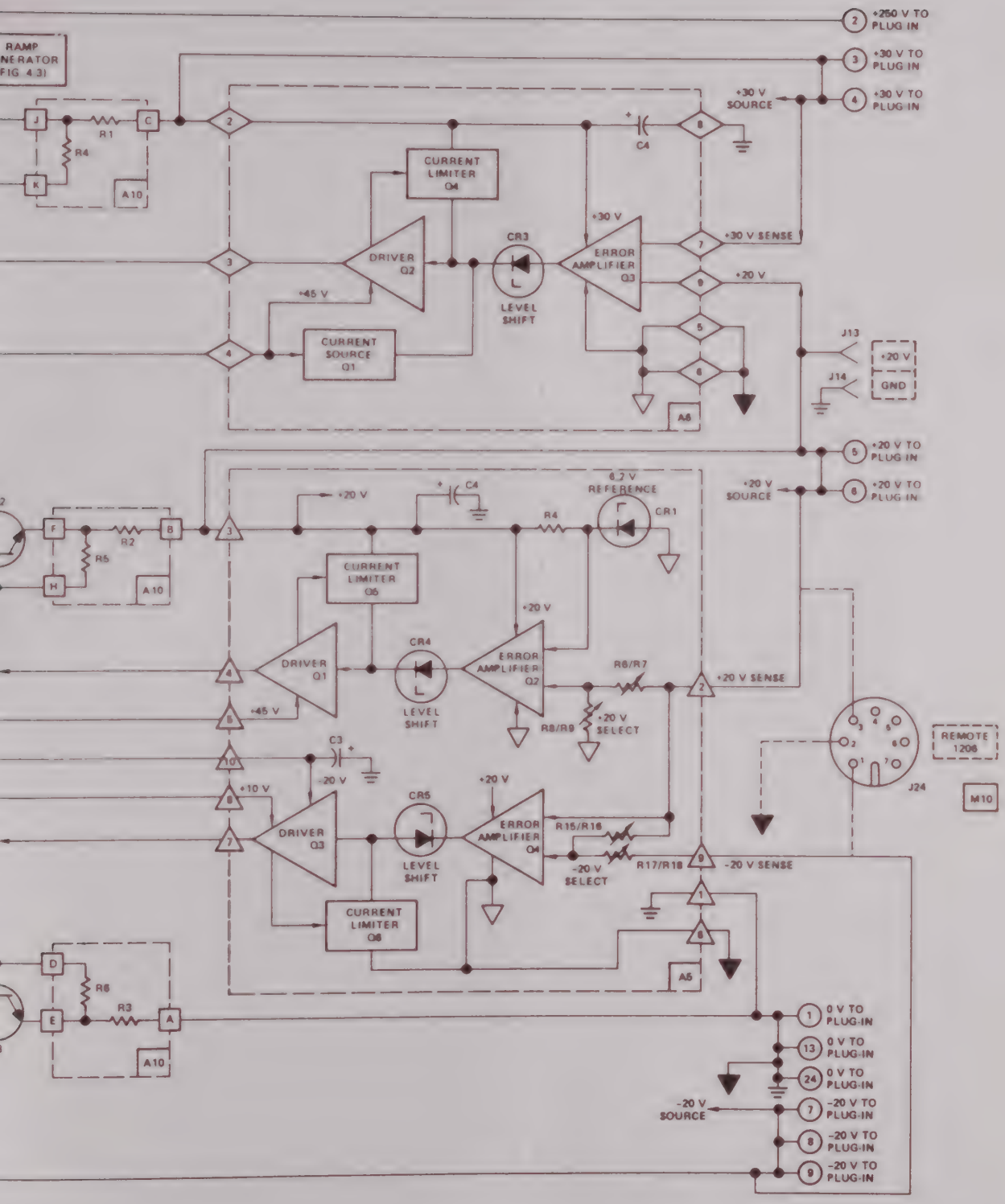


Figure 4-2. Power Supply Simplified Schematic Diagram

Cooling fan B1 is wired directly across the upper 115-volt primary winding. Whether the power line input is set for 104 volts, 115 volts, 208 volts, or 230 volts, the fan power is always 115 volts. Neon power indicator I1 is connected through current-limiting resistor R1 across the lower 115-volt primary winding. Therefore, the line-powered devices in the plug-in are provided with 115-volt power at all times, despite the actual input range selected.

Fuse F1 is manually changed by the operator from one Ampere for 104 and 115-volt operation to one-half Ampere for 208 and 230-volt operation; slow-blowing fuses are used to eliminate needless fuse blowing on transients and input surges.

4-2.1.2 **PLUS 250 VOLT SUPPLY.** The plus 250-volt supply consists of a 176-volt (rms) transformer winding, half-wave rectifier A7CR1, and filter capacitor A7C1. The dc output is coupled through pin J on power supply printed circuit board A7 directly to pin 2 of plug-in interface connector J20; some RF plug-ins use the plus 250-volt output in the tuning voltage processing circuits. Resistor A7R3 is a bleeder for A7C1.

This power supply is unregulated; at its maximum output current of 40 milliamperes, the voltage may drop to as little as 125 volts. Greater precision is not necessary.

4-2.1.3 **LINE TRIGGER REFERENCE.** Voltage divider A7R1/A7R2 is connected across the 176-volt winding of transformer A7T1; the ratio of the divider is about 31 to 1, so a line-frequency sine-wave of approximately 5 volts rms (14 volts peak-to-peak) is fed through pin A7-K to the ramp generator circuit.

4-2.1.4 **PLUS 20 VOLT SUPPLY.** The plus 20-volt output of the power supply provides operating power for the 5000A mainframe and operating power for the plug-in, and serves as a reference for the minus 20-volt and plus 30-volt supplies. Note that the total current available from the plus 20-volt and plus 30-volt supplies is 1.2 Amperes; approximately 200 milliamperes is used within the 5000A, with 1 Ampere available for the plug-in.

A high-current winding on transformer A7T1 provides about 33 volts rms to a full-wave bridge rectifier consisting of diodes A7CR2 through A7CR5; capacitor A7C2 serves as a filter. The negative output of the bridge is connected to board common, which is in turn connected to the chassis of the 5000A through A7-M. The positive output of the rectifier/filter, about 45 volts dc, is fed through A7-L to chassis-mounted resistor R2. Output current is coupled through voltage-dropping resistor R2, series pass transistor Q2, and current-limiting resistor A10R2 to pins 5 and 6 of plug-in interface connector J20.

The plus 20-volt output and the plus 20-volt sense input are connected together at the plug-in interface connector. Remote sensing for the power supply is accomplished at the plug-in interface connector because the highest current demands are expected to be in the plug-in.

Error amplifier A5Q2 is an operational amplifier which compares the plus 20-volt sense input through A5-2 to a reference level generated by reference diode A5CR1; the reference diode is a low-noise Zener diode selected for accuracy and predictable temperature coefficient. The exact output voltage of the plus 20-volt supply is determined by the ratio of resistor values in the sense voltage divider, A5R6/A5R7 and A5R8/A5R9.

Driver transistor A5Q1 and pass transistor Q2, connected in a Darlington configuration, are driven by the output of error amplifier A5Q2 through Zener diode A5CR4. When the output voltage of the supply varies from its calibrated level. the output of A5Q2 increases or decreases the base drive to A5Q1 (and consequently to Q2) to compensate.

The plus 20 volt power supply includes two separate current/overvoltage limiters; the drive current to the base of A5Q1 is limited to its normal operating range by transistor A5Q5. This transistor sinks the drive to A5Q1 in the event of a failure in the sense line, A5CR1, A5Q2, or A5CR4 which would otherwise cause the plus 20 volt output to reach voltage levels which could damage the 5000A or plug-in. When current demands are excessive, as in the case of a short circuit, the voltage drop across A10R2 increases and current is coupled through A10R5 from the emitter to the base of Q2; when the emitter and base voltages have a differential of less than about 600 millivolts, the transistor turns off.

4-2.1.5 MINUS 20 VOLT SUPPLY. The minus 20-volt power supply is similar in operation to the plus 20-volt power supply, but neither output of the bridge rectifier is grounded. The negative output of the bridge is coupled to pins 7, 8, and 9 of J20 and to the internal circuitry of the 5000A. Regulation of the minus 20-volt output takes place in pass transistor Q3 connected between the positive output of the rectifier and 5000A chassis ground. The error amplifier, driver, and current limiter circuits of the minus 20-volt supply operate in the same manner as those of the plus 20-volt supply, but the negative supply does not have its own voltage reference. Instead, the minus 20-volt supply is referenced to the plus 20-volt supply. This arrangement allows the two supplies to track very closely. The minus 20-volt output and minus 20-volt sense lines are connected together at J20. A current of 1.2 Amperes is available from the minus 20-volt supply; approximately 200 milliamperes is used within the 5000A, with 1 Ampere available for the plug-in.

4-2.1.6 PLUS 30 VOLT SUPPLY. The plus 30-volt regulator circuits are powered by the same 45-volt dc source from which the plus 20-volt supply operates; a combined total of 1.2 Amperes is available from the plus 20 and plus 30 volt outputs. Approximately 200 milliamperes is drawn from the plus 20-volt supply for use within the 5000A, but less than 20 milliamperes from the plus 30-volt supply. The current limit of the plus 30-volt supply is set for 800 milliamperes.

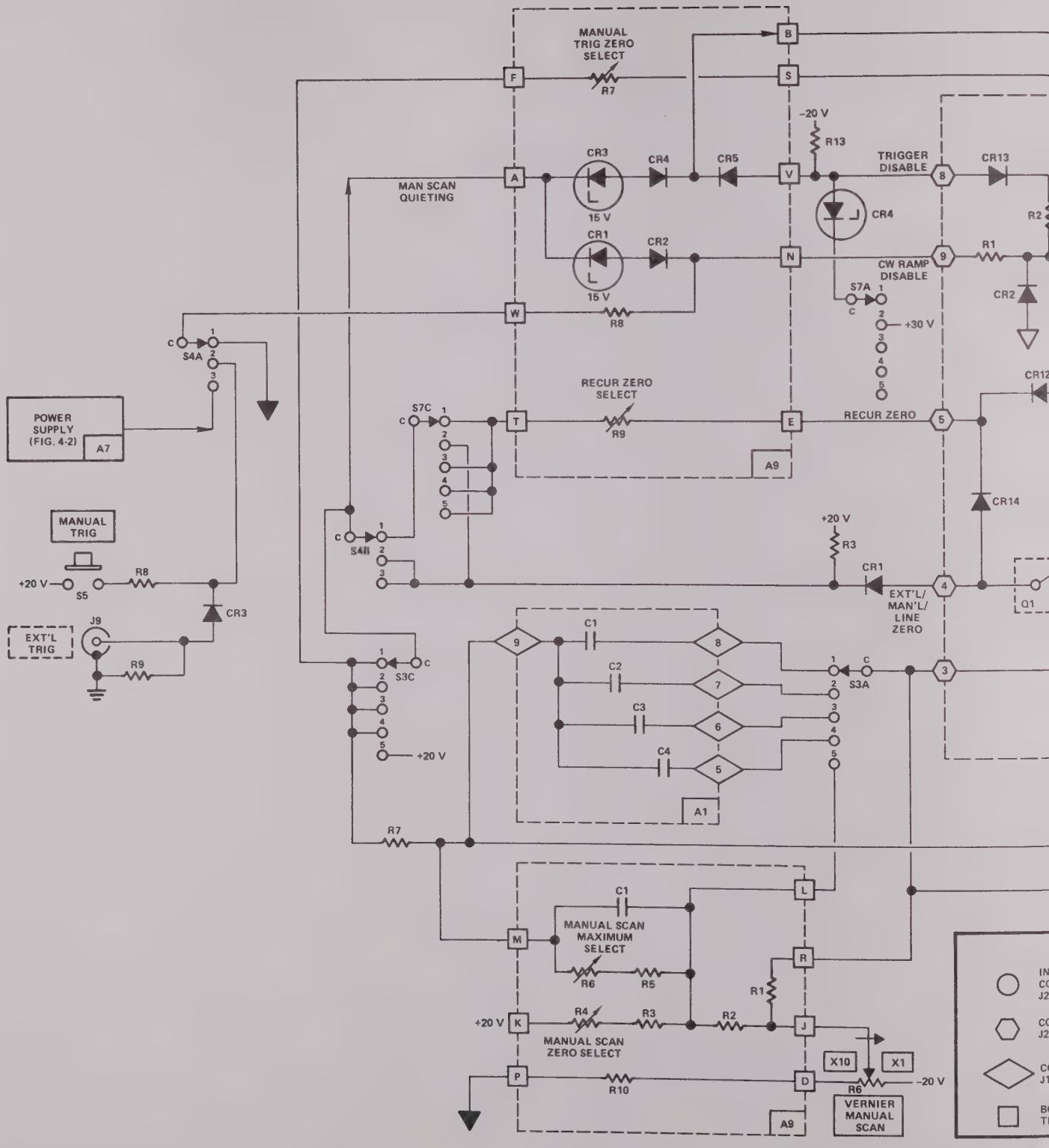
The regulator circuits of the plus 30-volt supply, on printed circuit assembly A6, are similar to those of the plus 20-volt supply described above. A reference voltage from the plus 20-volt supply is compared to the 30-volt output at pins 3 and 4 of interface connector J20; error amplifiers A6Q3, an operational amplifier, provides drive to keep the output differential between the two supplies a constant 10 volts.

The output of current source A6Q1 is constant; A6Q1 supplies base drive to A6Q2, which in turn drives series regulator Q1 on the chassis. A6Q3 sinks current from A6Q1 as necessary to keep the plus 30-volt level constant; when the output is lower than plus 30 volts, A6Q3 sinks less current from A6Q1 than under normal conditions. The extra current flows into A6Q2, raising the output voltage. Similarly, when the sensed output exceeds plus 30 volts, A6Q3 sinks more current from A6Q1 to decrease the output. This arrangement is used because A6Q2 alone could not safely provide sufficient base drive for Q1.

The current limiting circuits in the 30-volt supply operate in the same manner as those in the 20-volt supply.

4-2.2 Ramp Generator (Figure 4-3)

4-2.2.1 INTEGRATOR. The basic circuit in the 10-volt linear ramp generator used in the 5000A is a Miller integrator. A Miller integrator is a high-gain operational amplifier which uses a capacitor as a feedback element. Such a device maintains a constant current at its summing junction, so the voltage across the feedback capacitor rises linearly. If the capacitor is periodically discharged and the integration process is then allowed to begin again, the voltage across the capacitor would be a train of repetitive linear ramps with the appearance of a sawtooth. The ramp generator in the 5000A has several embellishments and refinements that make it suitable for its function in a sweep generator, but it is basically a simple Miller integrator ramp generator.


MANUAL TRIG ZERO SELECT
R7
F
B
S
-20 V
R13
CR3
CR4
CR5
V
TRIGGER DISABLE
8
CR13
MAN SCAN QUIETING
A
15 V
CR4
R2
CR1
CR2
N
9
R1
CW RAMP DISABLE
S7A
CR2
15 V
W
R8
+30 V
S4A
POWER SUPPLY (FIG. 4-2)
A7
RECUR ZERO SELECT
S7C
T
R9
E
RECUR ZERO
5
CR12
A9
CR14
MANUAL TRIG
+20 V
R3
S4B
CR1
EXT'L/ MAN'L/ LINE ZERO
4
Q1
+20 V
R8
S5
CR3
J9
EXT'L TRIG
R9
C1
C2
C3
C4
9
8
7
6
5
S3C
S3A
3
+20 V
A1
R7
C1
L
MANUAL SCAN MAXIMUM SELECT
M
R
R6
R5
R1
+20 V
K
R4
R3
R2
J
MANUAL SCAN ZERO SELECT
X10
X1
P
R10
D
R6
-20 V
VERNIER MANUAL SCAN
A9

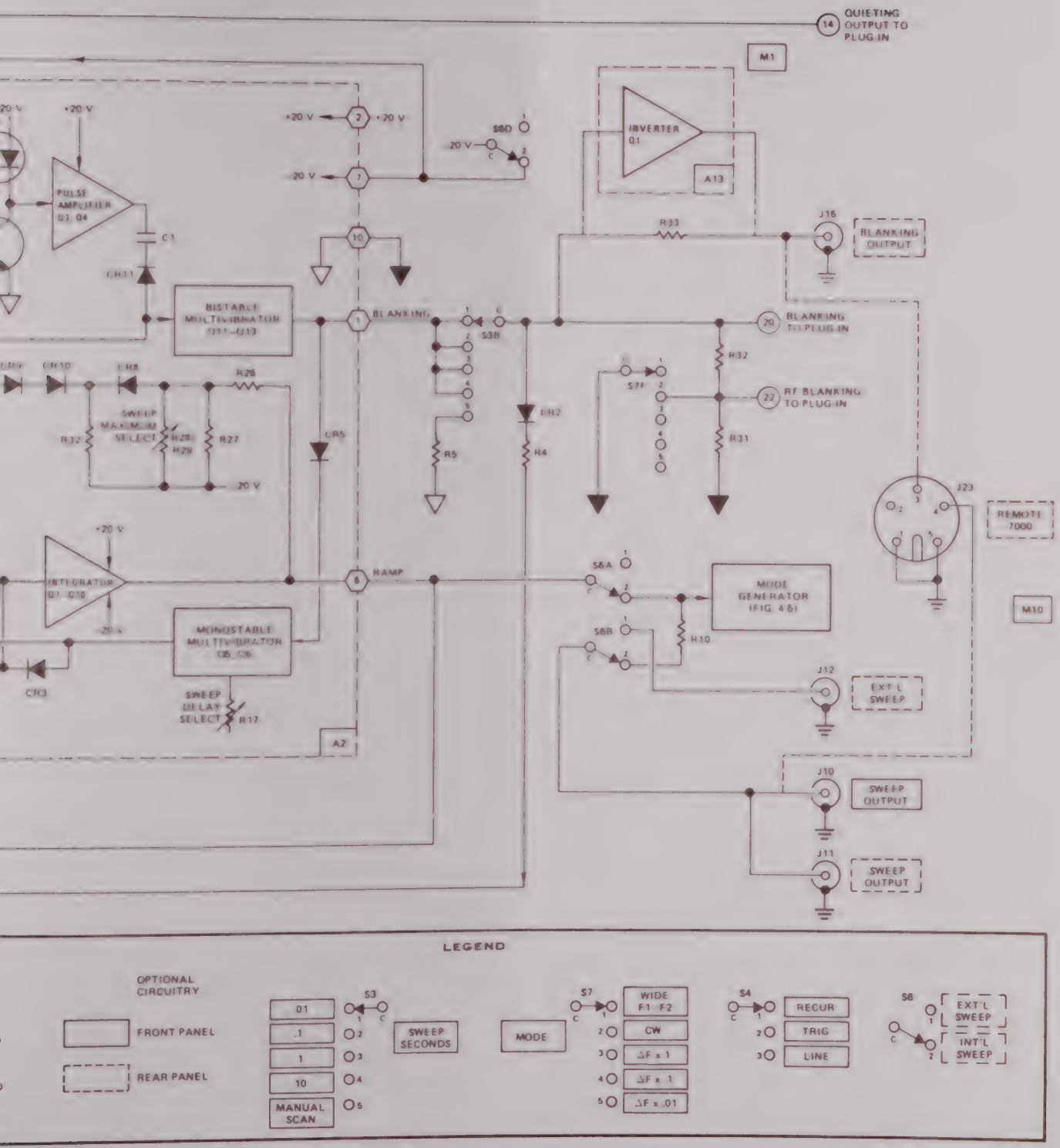


Figure 4-3. Ramp Generator Simplified Schematic Diagram

Transistors Q7 through Q10 on Trigger-Sweep Assembly A2 comprise the operational amplifier. The output of the operational amplifier is fed back to the input through pin 6 of A2, pin 9 of Timing Capacitor Assembly A1, one of the timing capacitors, pin 5, 6, 7, or 8 of A1, **SWEEP SECONDS** switch section S3A, and pin 3 of A2. An operational amplifier with a capacitor feedback element — a Miller integrator — is formed in this manner. Actually, a Miller integrator with a choice of four feedback capacitors has been formed, with a choice of ramp periods. With the **SWEEP SECONDS** switch set to **.01 SECONDS** as shown in Figure 4-3, the selected capacitor has a value of 10 nanofarads and an integration time of 10 milliseconds.

4-2.2.2 **VERNIER.** The Mylar® capacitors on A1 have been selected for this circuit because of their accuracy, stability, and low leakage. Accuracy and stability are obviously desirable characteristics in a timing device such as the 5000A ramp generator; low leakage is desirable because a resistance path around the capacitor would allow some direct current to flow into the summing junction of the A2Q7 through A2Q10 operational amplifier and modify the charging rate of the capacitor. In the 5000A ramp generator, the **VERNIER/MANUAL SCAN** potentiometer is programmed to do exactly that. The basic charging rate of the capacitor is modified by feeding opposite-polarity current into the summing junction through potentiometer R6, A9-J, A9R1, A9-R, and A2-3.

4-2.2.3 **BLANKING.** The Miller integrator will continue charging to the power supply limits if the capacitor is not discharged; the 5000A requires a ramp signal with a peak amplitude of 10 volts. Diodes A2CR8 through A2CR10 form a simple comparator; when the ramp reaches the plus 10 volt level, A2CR9/A2CR10 change from being forward-biased to being reverse-biased and cause transistor A2Q11 to turn on. The bistable multivibrator (flip-flop) comprising A2Q11 through A2Q13 changes output state from near-zero to approximately plus 19 volts. This output pulse is coupled through A2-1 and S3B to serve as the sweep blanking signal.

The blanking output is fed from S3B-C through diode CR2 and resistor R4 to A2-3, where it serves the function of discharging the timing capacitor. Discharge is not immediate because R4 is a high-value resistor; the R-C time constant of R4 and the selected timing capacitor causes downward integration to occur in one-tenth the period required for forward integration (ignoring the possible effects of **VERNIER/MANUAL SCAN** potentiometer R6 on forward integration time). Diode CR2 acts as a switch, disconnecting R4 from the summing junction at A2-3 during forward integration.

The blanking output is fed from S3-B to the RF plug-in through J20-20 and through a voltage divider comprising resistors R31 and R32 through J20-22. The blanking amplitude at J20-22 is about 5 volts; most RF plug-ins use this reduced blanking pulse rather than the full-amplitude blanking pulse.

The blanking output is coupled to external instruments through resistor R33 and **BLANKING OUTPUT** connector J16.

Sweepers equipped with Option M1 have an additional A13 Blanking Inverter assembly which produces a blanking output of minus 19 volts. The blanking inverter circuit consists of a single transistor, a diode, and a few resistors.

4-2.2.4 **RECURRENT MODE.** Thus far a single ramp cycle has been examined, from the start of integration through triggering the bistable (blanking) multivibrator when the ramp reached the 10-volt level to cause the consequent downward integration of the ramp. In order to allow integration to begin again, it will be necessary to reset the bistable multivibrator.

Figure 4-3 shows the **SWEEP SECONDS** switch set to **.01 SECONDS**, the **RECUR-TRIG-LINE** switch set to **RECUR**, and the **MODE** switch set to **WIDE F1—F2**. In this configuration, the sweep ramp output at A2-6 is coupled through R7, S3C-1, S4B-1, S7C-1, A9-T, A9R9, and A2-5 to the cathode of diode A2CR12. When the sweep ramp reaches the zero-volt level at the end of downward integration,

A2CR12 becomes forward-biased and causes transistor A2Q11 to turn off. The output state of multivibrator A2Q11 through A2Q13 changes state and the blanking output level returns to near-zero. Forward integration in the Miller integrator could begin again.

4-2.2.5 DELAY GENERATOR. Normally, the RF plug-in installed in the 5000A would be driven by this sweep ramp to cover a very wide frequency range (the exact frequency coverage is determined by the settings of frequency controls in the mode generator circuits). The oscillator module in the RF plug-in would have been tuned from the low-frequency end of its range to the high-frequency end of its range in less than 10 milliseconds, then tuned in the reverse direction in less than a millisecond. It is desirable to allow a certain delay time for the RF components to "settle" before beginning another forward sweep. This "settling" time allows stray magnetic or capacitive or inductive charges to dissipate and generally contributes to improved performance of the plug-in.

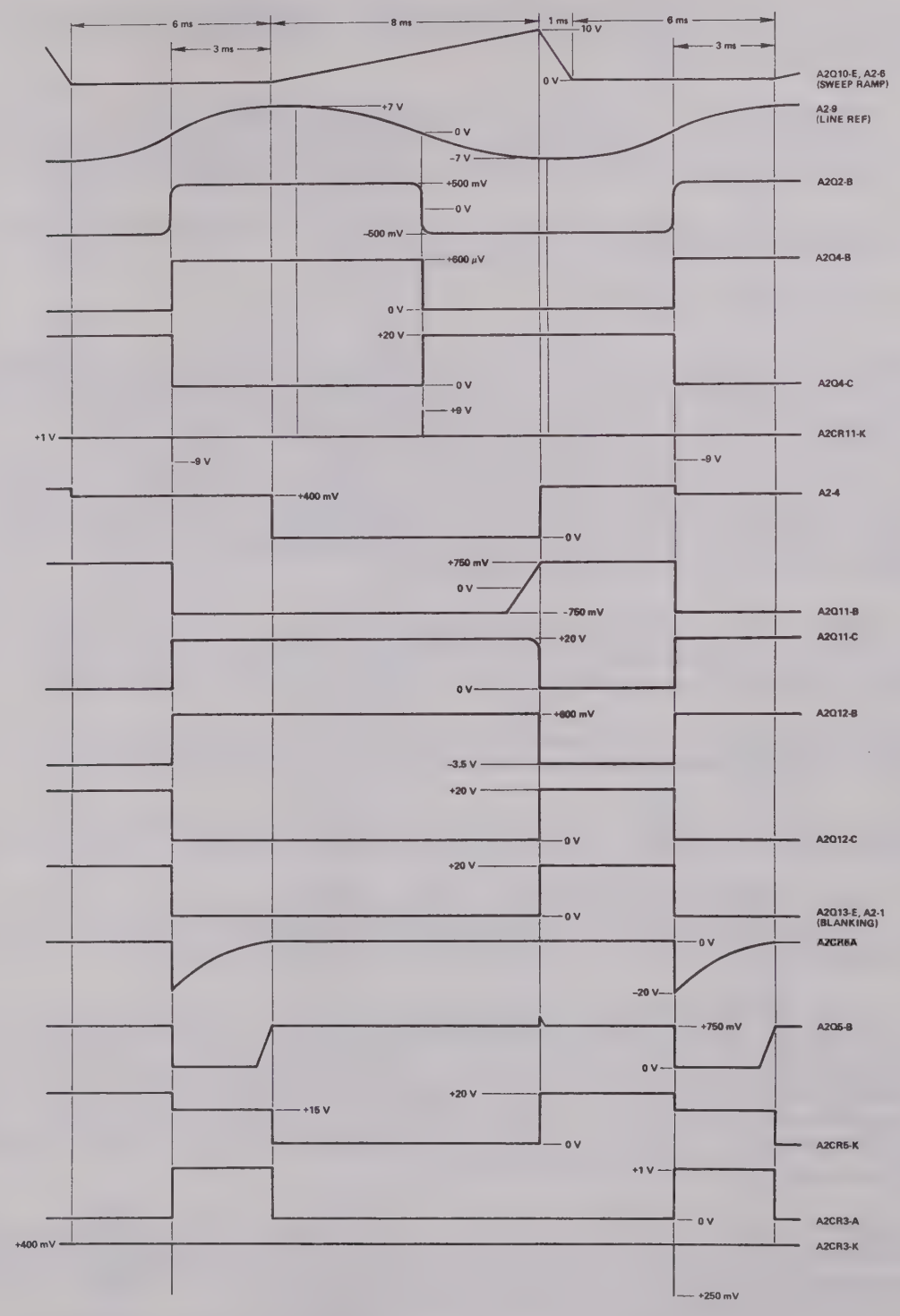
When the output state of A2Q11 through A2Q13 changes to zero, the output of monostable (delay) multivibrator A2Q5/A2Q6 goes high for a period of three milliseconds. The output of A2Q5/A2Q6 is coupled through diode A2CR3 to the input of Miller integrator A2Q7 through A2Q10 to keep the integrating capacitor discharged; the output of the delay multivibrator also turns on IGFET (insulated gate field-effect transistor) A2Q1. This type of transistor has extremely low "on" resistance, and it keeps diode A2CR12 biased through A2CR14 to keep bistable multivibrator A2Q11 through A2Q13 held in its low output state. At the end of the three-millisecond delay period, the A2Q5/A2Q6 output drops, opening switches A2Q1 and A2CR3 so integration can begin again.

4-2.2.6 LINE TRIGGER MODE. When switch S4 is set to **LINE**, the ramp initiation does not begin automatically three milliseconds after the end of the previous sweep. A line-frequency reference signal from the power supply is coupled through S4A-3, A9-W, A9R8, A9-N, A2-9, and A2R1 to the base of transistor A2Q2. The sine-wave input is rectified and clamped by A2CR2. Timing diagram Figure 4-4 shows the relationships between the line trigger reference and the input to the pulse generator comprising transistor A2Q2 and tunnel diode A2CR1; the pulse generator shapes the input reference into a square wave with fast-rising leading and trailing edges. The trigger pulse is amplified by A2Q3/A2Q4, differentiated by A2C1, and coupled through diode A2CR11 to the input of bistable (blanking) multivibrator A2Q11 through A2Q13. Each negative pulse through A2CR11 causes the multivibrator to change state, dropping the blanking output to near-zero. Integration is begun again after the normal three millisecond delay period (refer to Paragraph 4-2.2.5). Operation of the delay generator is similar in line trigger mode to that in recurrent mode, but the zero reference for the ramp is established by bias from the minus 20-volt supply at A2-7 through A9-S, A9R7, A9-F, S3C, and S4B. Plus 20-volt bias through high-value resistor R3 is summed with the minus 20-volt bias at the cathode of CR1, clamping A2-4 to the zero reference.

4-2.2.7 EXTERNAL TRIGGER MODE. External trigger operation is similar to line trigger operation, but an external input signal is used rather than the internal line trigger reference. Positive-going input signals are coupled through **EXT'L TRIG** connector J9 and diode CR3 to S4A-2. When S4 is set to **TRIG**, the inputs are connected to A9-W; from that point, trigger operation is identical to that described in Paragraph 4-2.2.6.

4-2.2.8 MANUAL TRIGGER MODE. In the absence of an external signal (or in addition to it), when S4 is set to **TRIG**, **MANUAL** switch S5 may be pressed by the sweeper operator to initiate sweep trigger. A dc level through resistor R8 is coupled through S4A-2 to A9-W. Diode CR3 prevents the manual trigger from being coupled back to any external generator which may be connected to J9.

4-2.2.9 MANUAL SCAN. Setting **SWEEP SECONDS** switch S3 to **MANUAL SCAN** converts Miller integrator A2Q7 through A2Q10 to a dc amplifier with resistive feedback. The conversion is accomplished in Sections A and C of switch S3; potentiometer R6 controls the dc output level at A2-6 from zero to plus 10 volts. Although the blanking multivibrator has a high output when Manual Scan mode is selected, there is no blanking output to the plug-in or to J16; the output is disabled by S3B.



1) SWEEP SECONDS switch S3 set to .01 SECONDS
2) VERNIER/MANUAL SCAN control R6 set to X1
3) RECUR-TRIG-LINE switch S4 set to LINE
4) Power line frequency is 60 Hz

Figure 4-4. Ramp Generator Timing Diagram

4-2.2.10 MANUAL SCAN QUIETING. Plus 20-volt bias is coupled through S3C-5 to A9-A; the amplitude is dropped by the Zener value of A9CR3 and the plus five-volt quieting command is coupled through A9CR4 and A9-B to J20-14.

4-2.2.11 CW MODE. The ramp generator is disabled when the MODE switch is set to CW; a plus 30-volt bias through S7A and 24-volt Zener diode CR4 disables the trigger generator. Switch S7C disconnects the recurrent zero reference, and S7F grounds J20-22 to disable RF blanking to the plug-in.

4-2.2.12 CW QUIETING. The plus six-volt level at A9-V is coupled through A9CR5 and A9-B to J20-14 to activate the quieting circuits of the RF plug-in.

4-2.3 Mode Generator (Figure 4-5)

The mode generator circuits accept the zero to plus ten-volt sweep output of the ramp generator, the zero to plus ten-volt manual scan output of the ramp generator, or an external sweep input; the selected input signal is processed by the circuits on Dual Operational Amplifier Assembly A8 and the various frequency-control potentiometers, then fed to Single Operational Amplifier Assembly A3; this board integrates and sums three separate inputs into a zero to minus 10 volt frequency reference for the RF plug-in. The three inputs are the output of EXT'L SWEEP/INT'L SWEEP switch S6C, the output of MODE switch S7D, and the VERNIER input from the plug-in; each plug-in contains a resistive voltage divider which scales the zero to plus 20 volt output of VERNIER potentiometer R30 by a factor which is proportional to the frequency coverage of the plug-in.

4-2.3.1 SIGNAL FLOW, INTERNAL SWEEP MODE. When rear-panel EXT'L SWEEP/INT'L SWEEP switch S6 is set to its normally-closed INT'L SWEEP setting, the sweep (or manual scan) output of the ramp generator is coupled through S6A-2 to A8-8 and to S7H-1 for subsequent processing.

The output of the ramp generator is also coupled through resistor R10 and switch S6B-2 to connectors J10 and J11. These connectors are the front-panel and rear-panel SWEEP OUTPUT jacks.

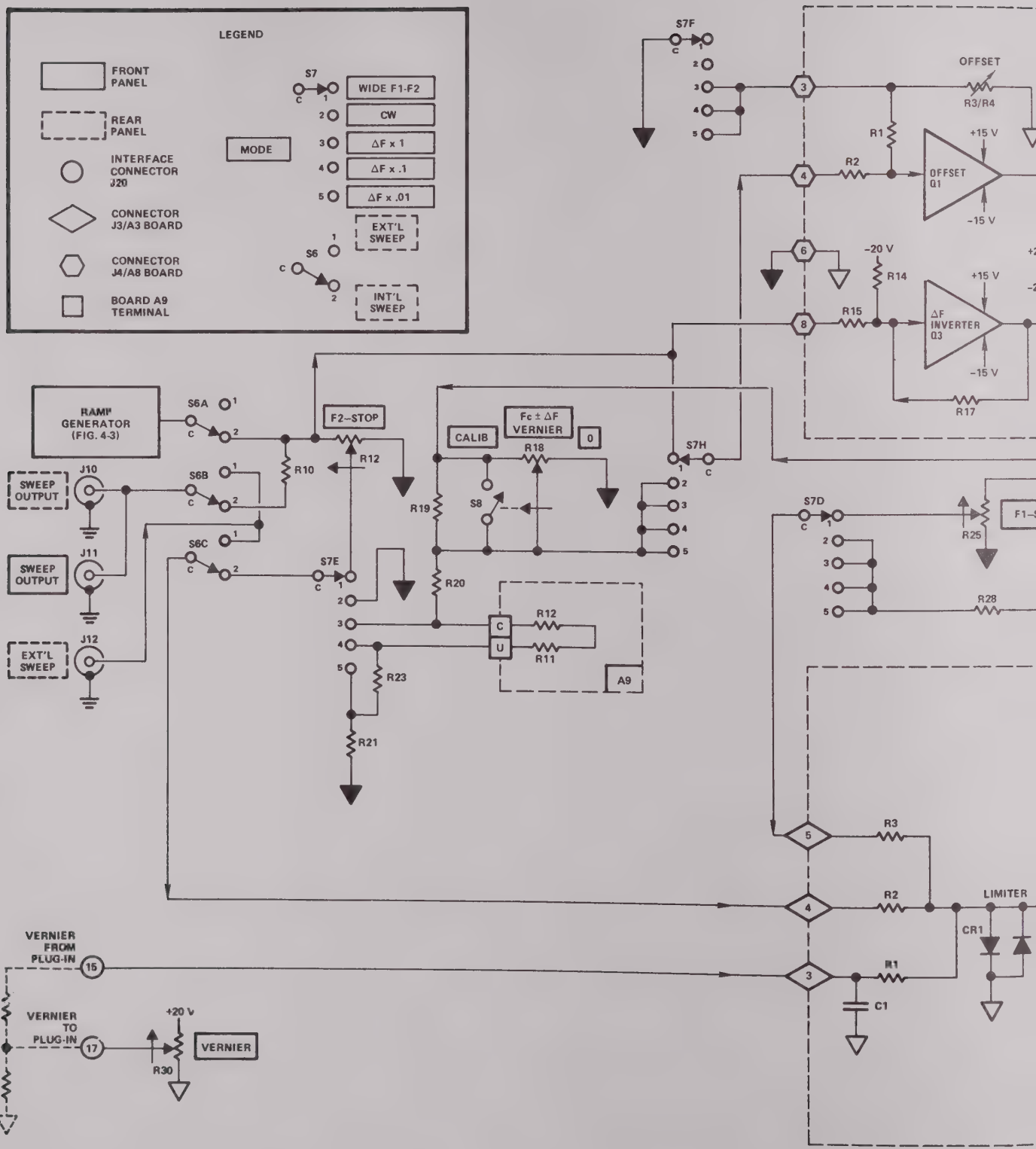
Switch S6C connects the output of switch S7E to A3-4. The functions of MODE switch S7, boards A8 and A3, and the rest of the mode generator circuits are described in Paragraphs 4-2.3.3 through 4-2.3.5.

4-2.3.2 SIGNAL FLOW, EXTERNAL SWEEP MODE. When S6 is set to EXT'L SWEEP, the ramp generator output is disconnected from the mode generator by S6A; the external input signal is coupled to the two SWEEP OUTPUT connectors through S6B-1, and to A3-4 through S6C-1.

4-2.3.3 SIGNAL FLOW, WIDE F1—F2 MODE. In internal sweep mode, the output of the ramp generator through S6A is coupled through S7H-1 to A8-4; this input is coupled through A8R2 to the non-inverting input of integrated circuit operational amplifier A8Q1. The zero to plus 10-volt ramp input is offset positively by A8Q1; the offset voltage is set by resistors A8R3/A8R4. The output of A8Q1 is inverted and further offset by transistor A8Q2 and fed to the board output at A8-7. The output at A8-7 in Wide F1—F2 mode is an inverted version of the ramp input, offset to an amplitude of plus 10 to zero volts (refer to timing diagram Figure 4-6).

The offset/inverted ramp (or offset/inverted manual scan voltage) is fed to potentiometer R25, the F1—START control. The output of R25 is fed through S7D-1 to pin 5 of A3. At the same time, the ramp generator output is fed directly to F2—STOP control R12. The selected portion of the input ramp (or manual scan voltage) is coupled through S7E-1 and S6C-2 to A3-4.

Printed circuit assembly A3 contains a dual transistor (A3Q1) and three discrete transistors (A3Q2, A3Q3, and A3Q4) configured as a unity-gain operational summing amplifier for each input; unity gain is determined in this operational amplifier by the fact that resistors A3R2 and A3R3 are each equal in value to feedback resistor A3R4.


LEGEND
FRONT PANEL
REAR PANEL
INTERFACE CONNECTOR J20
CONNECTOR J3/A3 BOARD
CONNECTOR J4/A8 BOARD
BOARD A9 TERMINAL
S7
WIDE F1-F2
CW
ΔF x 1
ΔF x .1
ΔF x .01
EXT'L SWEEP
MODE
S6
INT'L SWEEP
S7F
OFFSET
R3/R4
R1
+15 V
R2
OFFSET Q1
-15 V
-20 V
R14
R15
ΔF INVERTER Q3
R17
RAMP GENERATOR (FIG. 4-3)
S6A
F2--STOP
R12
R10
CALIB
Fc ± ΔF VERNIER
R18
0
S7H
SWEEP OUTPUT
J10
S6B
R19
S8
S7D
R25
F1-
SWEEP OUTPUT
J11
S6C
S7E
R20
R28
EXT'L SWEEP
J12
C
U
R11
A9
R23
R21
R3
R2
LIMITER
CR1
VERNIER FROM PLUG-IN
15
R1
C1
VERNIER TO PLUG-IN
17
+20 V
VERNIER
R30

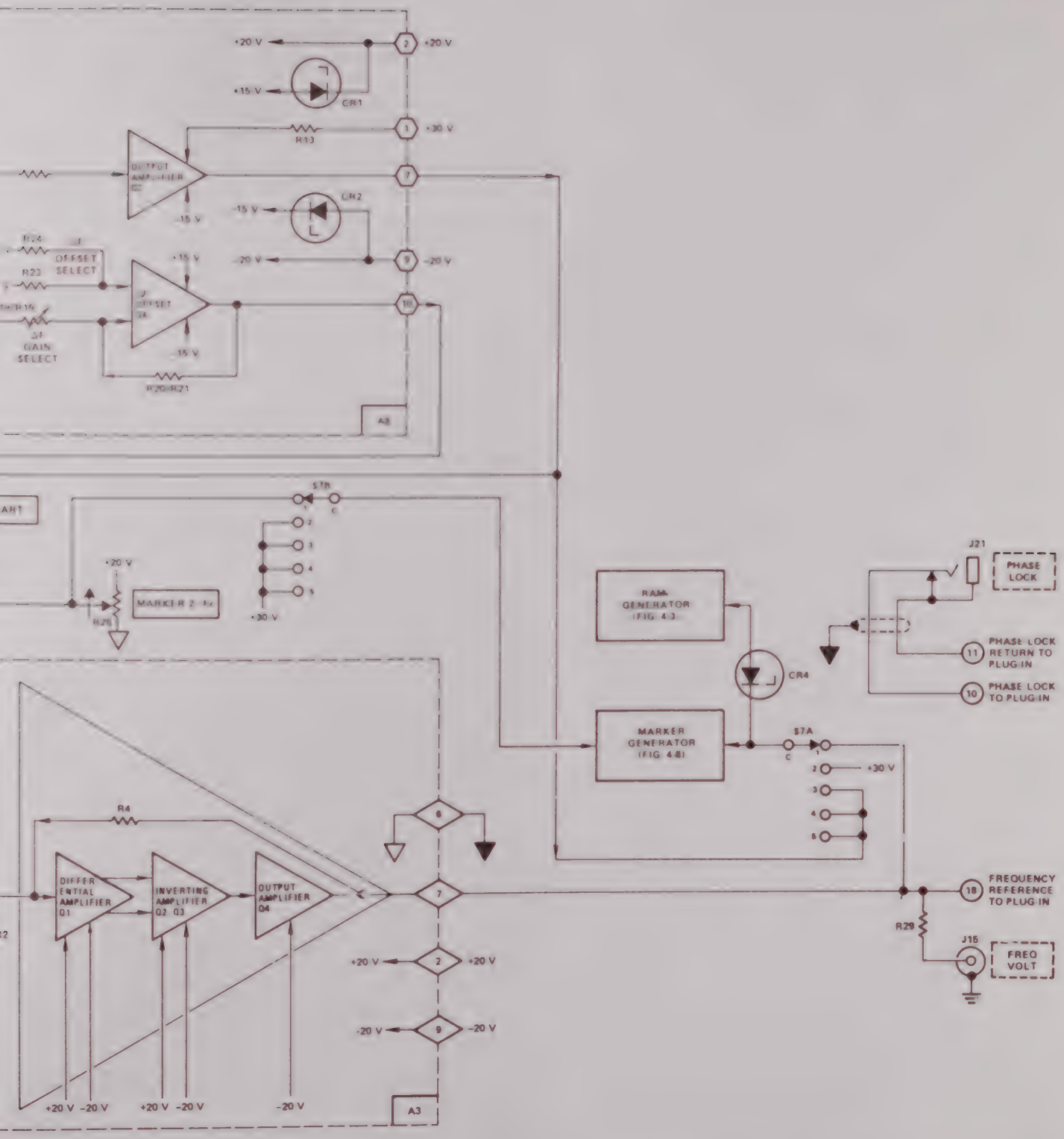
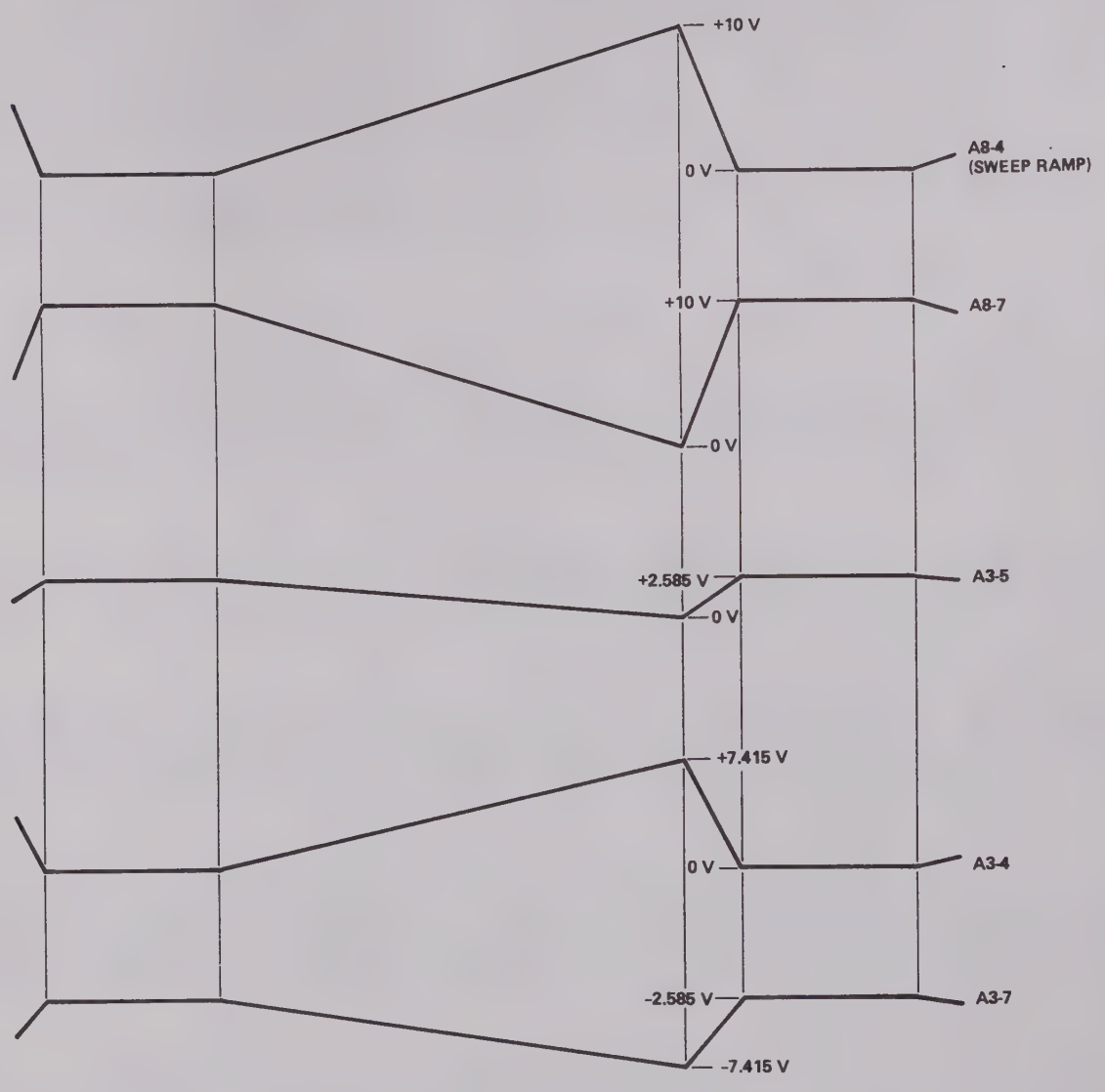


Figure 4-5. Mode Generator Simplified Schematic Diagram



1) MODE switch S7 set to WIDE F1–F2
2) SWEEP SECONDS switch S3 set to .01 SECONDS
3) VERNIER/MANUAL SCAN control R6 set to X1
4) VERNIER control R30 set to 0
5) F1–START control R25 set to 2.585 V (on 9210 calibration dial)
6) F2–STOP control R12 set to 7.415 V (on 9210 calibration dial)

Figure 4-6. Mode Generator Timing Diagram

The outputs of the F1–START control, the F2–STOP control, and the input, if any, from the VERNIER control (through the plug-in) are summed together in A3. When the F1–START control is set fully counterclockwise and the F2–STOP control is set fully clockwise (a normal configuration for sweeping from the lowest to the highest output frequency of a plug-in), the input to A3-5 is zero volts (R25 at ground) and the input to A3-4 is the 10-volt peak ramp from the ramp generator (R12 at maximum resistance). The output voltage to the plug-in and to the rear-panel FREQ VOLT connector is a zero to minus 10-volt ramp; in actuality, the F1–START and F2–STOP controls do not have to be set against their respective counterclockwise and clockwise stops to sweep the full band of the plug-in. All standard RF plug-ins are designed to sweep from the lowest to the highest specified usable frequency with a minus 0.1 to minus 9.9 volt ramp. The first and last marks on all standard dial scales are set for minus 0.1 and minus 9.9 volts.

When the positions are reversed — F1–START set fully clockwise and F2–STOP set fully counterclockwise — the output at A3-7 is a minus 10 to zero volt ramp (or discrete manual scan voltage). If potentiometers R12 and R25 are both set fully counterclockwise, the inputs to A3-4 and A3-5 are both zero; the output at A3-7 is zero. Similarly, when both controls are set fully clockwise, the inputs to A3-4 and A3-5 are equal and opposite; the zero to plus 10 volt ramp at A3-4 and the plus 10 to zero volt ramp at A3-5 add algebraically to produce a steady-state output of minus 10 volts at A3-7.

A typical example of this type of operation is shown in timing diagram Figure 4-6: operating in Wide F1-F2 mode and Internal Sweep mode, the F1–START control was set to 24.5 percent clockwise rotation; F2–STOP was set to 74.5 percent clockwise rotation. *(These figures are the second and fourth marks on the 9210 calibration dial for the 5000A.)*

The input from F1–START control R25 to A3-5 is a plus 2.585 to zero volt ramp; the input from F2–STOP control R12 to A3-4 is a zero to plus 7.415 volt ramp. These are added algebraically and inverted by the A3Q1 through A3Q4 operational amplifier to produce an output to the plug-in comprising a ramp of minus 2.585 to minus 7.415 volts; this will sweep any standard plug-in from 24.5 to 74.5 percent of its rated bandwidth.

The ramp fed to pin 18 of plug-in interface connector J20 is also coupled through S7A-1 to the marker generator to serve as a frequency reference; the ramp is also coupled through resistor R29 to rear-panel FREQ VOLT connector J15. Resistor R29 is used to prevent damage to the plug-in and to A3 if an external voltage is inadvertently connected to J15. Zener diode CR4, shown connected to S7A-C in Figure 4-5, is rated at 24 volts; the zero to minus 10 volt ramp at S7A-C in Wide F1—F2 mode is not coupled into the ramp generator.

The output frequency of the plug-in is also affected by an offset input to A3-3 from VERNIER potentiometer R30 through J20-17, a voltage divider in the plug-in, and J20-15. This input was referred to in preceding paragraphs. In addition, the output frequency of the plug-in may be modified by an external voltage or current input through PHASE LOCK connector J21 to J20-1- and J20-11; the phase lock input is not affected by the mainframe in any way. The phase lock voltage and/or current requirements and the frequency increment per electrical increment is listed in the applicable RF plug-in manual. J21 is a shorting connector; when the Model 9106 phase lock plug (a supplied accessory) is not inserted, the phase lock input to the plug-in is short-circuited to reduce stray pickup.

In external sweep mode, the external input signal is coupled directly to A3-4, bypassing F2–STOP control R12. The stop frequency is dependent on the peak positive amplitude of the external input signal. Since the input to A8-4 is zero in external sweep mode, the output at A8-7 is plus 10 volts *(A3Q1 and A3Q2 offset the input by 10 volts and invert it as described earlier).* Whatever portion of this plus 10 volts is selected by R25 is coupled through S7D-1 to A3-5, where it is summed with the external sweep input to set the lower sweep limit fed to the plug-in.

4-2.3.4 **SIGNAL FLOW, CW MODE.** When internal sweep mode is used, the summing input to A3-4 is held at zero volts (ground) through S6C-2 and S7E-2. A voltage level between zero and plus 20 volts dc is selected by **MARKER 2—Fc** potentiometer R26 and fed through R28 and S7D-2 to A3-5. Input resistors R28 and A3R3 are the same value and together equal twice the value of feedback resistor A3R4. The A3Q1 through A3Q4 operational amplifier operates with a gain of one-half, algebraically summing the output of R26 with the zero-volt level at A3-4 and inverting the sum. At maximum clockwise rotation of R26, the output to the plug-in at A3-7 is minus 10 volts.

Any offset input from R30 (**VERNIER**) or frequency-control input from J21 (**PHASE LOCK**) is handled as described earlier in Paragraph 4-2.3.3.

Switch S7B-2 couples plus 30 volt bias to the marker generator circuits to disable marker 1 and marker 3; 30-volt bias is also coupled through S7A-2 to disable marker 2 (a detailed description of this function is in paragraph 4-2.4).

The 30-volt bias at S7A-C is reduced to approximately six volts by Zener diode CR4 and fed to the ramp generator, functioning as a sweep trigger killer and as a quieting input for the plug-in (refer to Paragraph 4-2.2 for a detailed description).

If external sweep mode is used in conjunction with CW mode, the input at A3-4 comes from **EXT'L SWEEP** connector J12 through S6C. Positive inputs will be added to the **MARKER 2—Fc** input at A3-5; negative inputs will be subtracted. This technique is used to generate wide frequency modulation (FM) from an external generator. The input need not be symmetrical about zero.

4-2.3.5 **SIGNAL FLOW, Fc ± ΔF MODE.** When internal sweep mode is selected, the ramp generator output through S6A-2 is fed to A8-8; the sweep ramp is fed through A8R15 to integrated circuit operational amplifier A8Q3, where it is inverted and offset by five volts (refer to ΔF timing diagram Figure 4-7). The output of A8Q3 is inverted again by operational amplifier A8Q4, and the offset voltage is "trimmed" so the minus five to plus five-volt ramp output at A8Q10 is symmetrical about zero.

The ramp (or manual scan voltage) from A8-10 is wired to an attenuator comprising resistor R19, **Fc ± ΔF VERNIER** potentiometer R18, and mechanically-coupled **CALIB** switch S8. When the **Fc ± ΔF** control is set to **CALIB**, the full minus five to plus five-volt ramp from A8-10 is available; proportionally lower ramp amplitudes are available as R18 is rotated counterclockwise and shorting switch S8 is opened. At maximum counterclockwise rotation, zero volts is available from the ΔF attenuator.

The attenuator otuput has two uses: the signal is fed through resistor R20 to S7E-3 and A9-C. A voltage divider comprising A9R12/A9R11, R23, and R21 reduces the maximum ramp voltage available at S7E-3 to one volt peak-to-peak. This ramp or manual scan voltage is fed through S7E-C and S6C-2 to the summing junction of A3-4 (refer to timing diagram Figure 4-7).

The minus five to plus five-volt (maximum) ramp from the ΔF attenuator is also coupled through S7H-3, A8-4, and A8R2 to the non-inverting input of operational amplifier A8Q1. In Wide F2—F2 mode, this amplifier serves as an offset generator; the offset function is disabled in Fc ± ΔF mode by S7F, which grounds offset resistors A8R3 and A8R4 through A8-3.

Output amplifier A8Q2 offsets the output of A8Q1 to produce a zero to minus 10-volt ramp at A8-7. This output is fed through S7A-3 to the marker generator, which requires a zero to minus 10-volt ramp as a reference (as in Wide F1—F2 mode).

Potentiometer R26 functions as the center frequency (Fc) control in Fc ± ΔF mode. As was the case in CW mode, the zero to plus 20-volt ouput of **MARKER 2—Fc** potentiometer R26 is coupled through

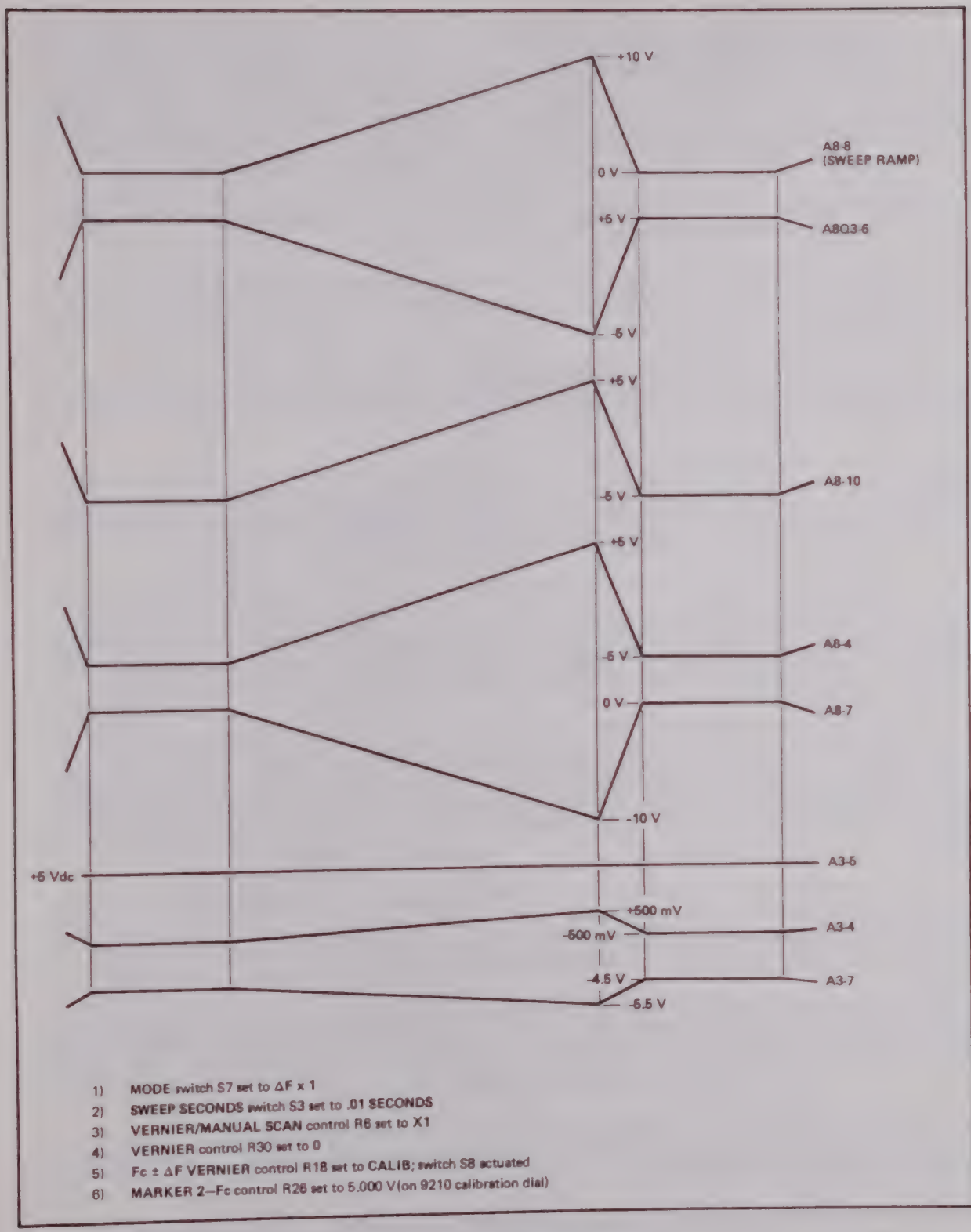


Figure 4-7. ΔF Timing Diagram

resistor R28 and switch S7D to A3-5. The A3 operational amplifier operates with a gain of one-half for the input at A3-5 and with a gain of one for the input at A3-4, producing a dc output of zero to minus 10 volts according to the setting of R26 modulated by the (up to) plus and minus 500-millivolt input at A3-4.

Operation in Fc ± ΔF x 0.1 and Fc ± ΔF x .01 is similar to that described for Fc ± ΔF x 1 mode, but the ratio of the voltage divider selected by S7E is changed to produce maximum ramp inputs to A3-4 of plus and minus 50 millivolts or plus and minus five millivolts; these correspond to plug-in bandwidths of plus and minus five percent (Fc ± ΔF x 1), 0.5 percent (Fc ± ΔF x 0.1), or .05 percent (Fc ± ΔF x .01). Plus and minus five percent coverage for an RF plug-in with a total bandwidth of 4.0 gigahertz, for example, is plus and minus 200 megahertz.

Plus 30 volts is coupled through S7B-3, S7B-4, or S7B-5 in Fc ± ΔF operation to disable marker 2. Vernier and phase lock operation are unchanged from CW mode operation. External sweep mode in Fc ± ΔF operating mode is identical to that previously described for external sweep/CW mode operation. The difference between these two methods is that the CW quieting circuits which reduce the bandwidth of the RF plug-in's frequency tuning circuits are activated in CW mode by a plus 30-volt command from S7A-2; plug-in quieting is not activated in external sweep/Fc ± ΔF mode.

4-2.5 Marker Generator (Figure 4-8)

Marker generator assembly A4 contains three similar circuits which generate negative-going triangular pulses used by the RF plug-in and/or external display devices to indicate reference points in the frequency output of the plug-in. Each marker generator is actually a coincidence detector with the marker pulse indicating a coincidence in voltage between the constantly-changing sweep ramp and a fixed voltage generated by one of the marker potentiometers.

Marker 1 is typical; a dc level of zero to plus 20 volts, determined by the setting of **MARKER 1** potentiometer R14, is coupled through A4-4 and resistor A4R9 to dual transistor A4Q4. At the same time, the frequency reference ramp from the mode generator (typically zero to minus 10 volts with **F1—START** set to maximum counterclockwise rotation and **F2—STOP** at maximum clockwise rotation) is coupled through S7A-1 to A4-6.

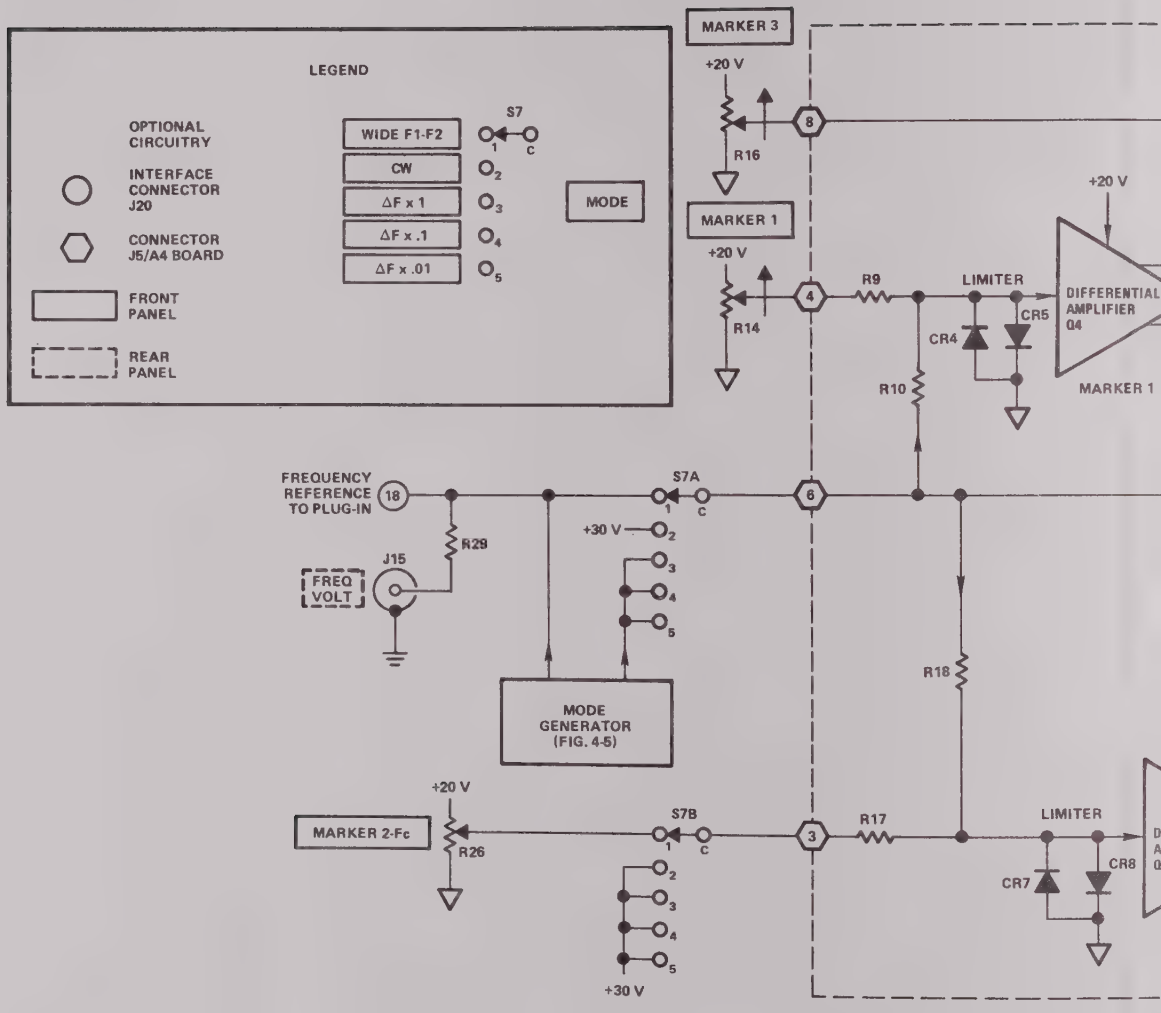
The value of resistor A4R9 is twice that of resistor A4R10; the gain of A4Q4 for inputs from **MARKER 1** control R14 is half that for the frequency reference voltage at A4-6. Transistor A4Q4 operates in a high-gain mode and is normally in saturation; at the point of coincidence, when the negative voltage at A4-6 is exactly half the positive voltage at A4-4, A4Q4 changes output state, then goes into saturation in the opposite direction. The crossover transient is shaped and amplified by A4Q5/A4Q6, then coupled through diode A4CR6 to the marker output at A4-7. The marker pulse is fed to the RF plug-in through J20-21 and connected to external instruments through connector J18 or through optional **REMOTE 7000** connector J23-2. Diode A4CR6 isolates the marker 1 output from the other marker outputs and ensures that only negative-going pulses are coupled to A4-7.

The circuit and the operation of marker 3 is identical to the circuit and operation of marker 1; marker 2 has two circuit changes from markers 1 and 3. Resistor A4R15 in the marker 1 shaping amplifier is the same value as resistor A4R7 in the marker 3 shaping amplifier. The corresponding resistor in the marker 2 shaping amplifier, A4R23, is 20 percent higher in value than the others; this causes the marker 2 pulse to be 20 percent greater in amplitude than markers 1 and 3.

Marker 2 functions only in Wide F1—F2 mode. **MARKER 2—Fc** potentiometer R26 is used within the mode generator in CW and Fc ± ΔF modes. When **MODE** switch S7 is set to **WIDE F1—F2**, the output of R26 is coupled through S7B-1 and A4-3 to the marker 3 generator circuits. In all other operating modes, a dc bias of plus 30 volts is coupled through S7B to keep A4Q7 in saturation at all times.

All markers are disabled in CW mode; a 30-volt dc bias fed through S7A-3 and A4-6 keeps A4Q4, A4Q1, and A4Q7 in saturation.

The required frequency reference ramp of zero to minus 10 volts is not available to the plug-in when the 5000A is operating in Fc ± ΔF mode. A special circuit in the mode generator provides the necessary ramp through S7A and A4-6 to the marker generators.


LEGEND
OPTIONAL CIRCUITRY
INTERFACE CONNECTOR J20
CONNECTOR J5/A4 BOARD
FRONT PANEL
REAR PANEL
S7
WIDE F1-F2
CW
ΔF x 1
ΔF x .1
ΔF x .01
MODE
MARKER 3
+20 V
R16
8
MARKER 1
+20 V
R14
4
R9
LIMITER
CR5
CR4
DIFFERENTIAL AMPLIFIER Q4
+20 V
MARKER 1
R10
FREQUENCY REFERENCE TO PLUG-IN
18
S7A
6
+30 V
R29
J15
FREQ VOLT
MODE GENERATOR (FIG. 4-5)
R18
MARKER 2-Fc
+20 V
R26
S7B
3
R17
LIMITER
CR7
CR8
+30 V

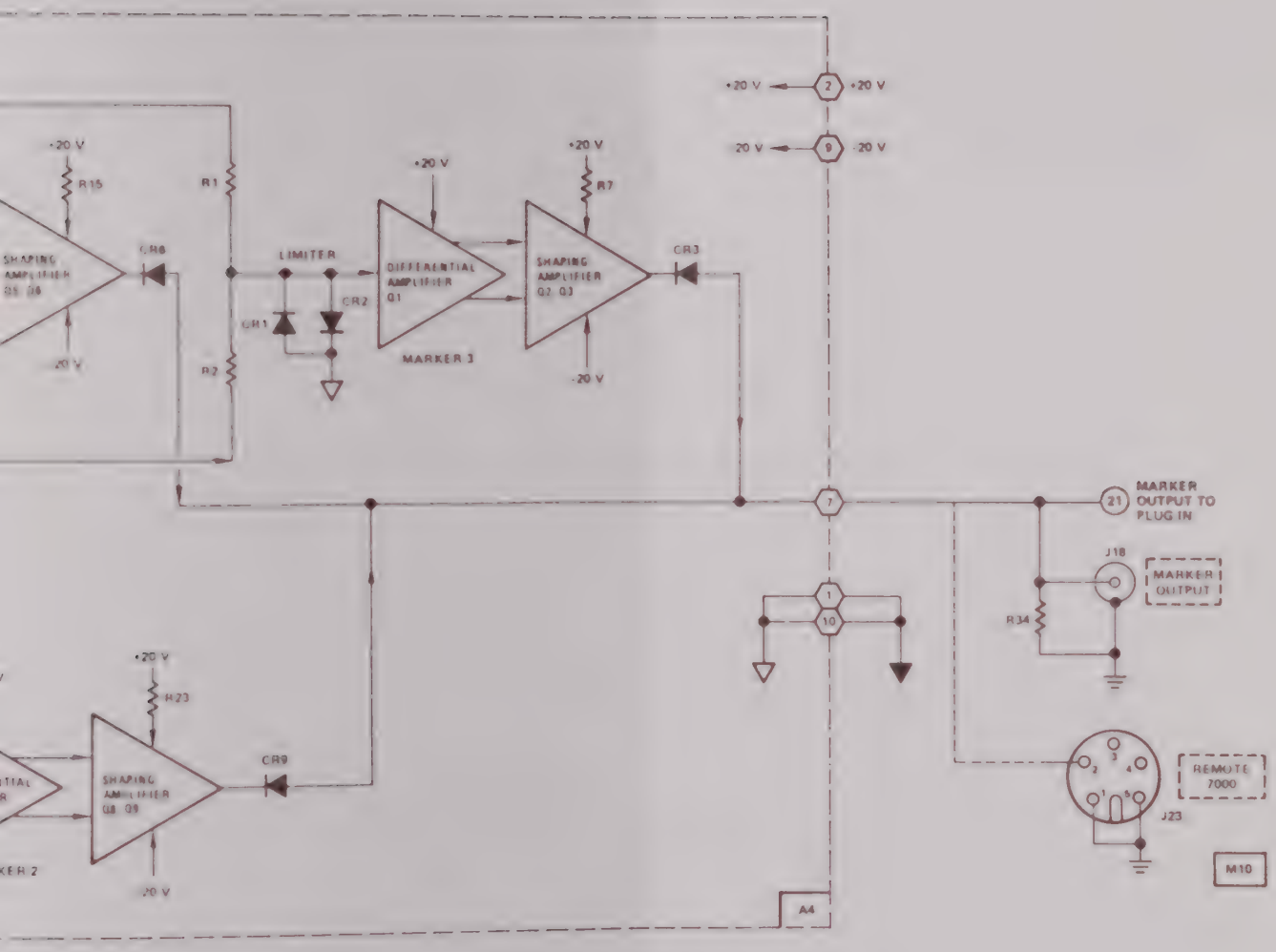


Figure 4-8. Marker Generator Simplified Schematic Diagram

SECTION V

PERFORMANCE CHECKS AND CALIBRATION

5-1. GENERAL

This section contains procedures for testing the electrical performance of the 5000A mainframe and calibrating the unit when necessary.

Calibration accuracy checks should be undertaken only by qualified personnel with sufficient experience and knowledge to ensure that proper test methods are employed. Use standard maintenance and metrology practices when working on the sweeper.

5-2. PERFORMANCE CHECKS

This paragraph contains the performance check procedures listed in Table 5-1. These performance checks verify that the instrument meets the applicable performance specifications in Table 1-1. Failure to meet the specified performance limits indicates the need for repair or recalibration in accordance with the procedure of Paragraph 5-3.

The following performance checks may be made at any time, and should be performed annually in the order indicated. If these checks reveal the need for repair or recalibration of the instrument, it should be returned to Systron-Donner or another qualified metrology laboratory so that the calibration procedure in Paragraph 5-3 may be accomplished.

5-2.1 Equipment Required

The test equipment required to check performance of the plug-in is listed in Table 5-2. All test equipment should bear evidence of recent calibration by a qualified metrology laboratory. Equipment equivalent to that listed in Table 5-2 may be used, but care should be taken to ensure that the rated accuracy of the equipment used is truly equivalent to that cited. In any case, the maximum rated inaccuracy of a piece of test equipment used to measure any parameter must not be greater than one-tenth the maximum inaccuracy which can be tolerated in the measurement.

If a test plug-in for the 5000A is not available, one should be constructed. Figure 5-1 is a schematic diagram of a power supply dummy load fixture that can be constructed for use in power supply performance checks and calibration.

It is not recommended that the 5000A be performance checked or calibrated using an RF plug-in for the following reasons:

1. The plug-in will probably not require the maximum currents available from the mainframe, so specified regulation of the supplies cannot be certified.

2. The RF plug-in could be exposed to damaging overvoltages in the event of inadvertent errors in test lead connection during measurements.

5-2.2 Initial Setup

5-2.2.1 DESCRIPTION. Various controls are preset to desired positions to facilitate subsequent measurements. Connect the equipment and set controls as described below. Do not apply power at this time.

Table 5-1. Performance Checks

PARAGRAPH NUMBER	PROCEDURE	SPECIFICATION REFERENCE ITEM (TABLE 1-1)
5-2.3.4	+250 Volt Power Supply Check	21.4
5-2.3.5	+20 Volt Power Supply Check	21.2
5-2.3.6	–20 Volt Power Supply Check	21.3
5-2.3.7	+30 Volt Power Supply Check	21.1
5-2.4.2	Sweep Time Check	7
5-2.4.3	Sweep Amplitude Check	10
5-2.4.4	Blanking Check	12
5-2.4.5	Sweep Trigger Check	6
5-2.4.6	Manual Scan Check	8
5-2.5.2	CW Mode Check	2.2
5-2.5.3	CW Mode Noise Check	—
5-2.5.4	Wide F1-F2 Mode Check	2.1
5-2.5.5	Fc ± ΔF Mode Check	2.3—2.5
5-2.6.2	Wide F2-F2 Sweep Mode Marker Check	15.1, 15.3
5-2.6.3	Fc ± ΔF Sweep Mode Marker Check	15.2, 15.3

Table 5-2. Test Equipment Required for Performance Checks

ITEM	TYPE OF EQUIPMENT	CHARACTERISTICS	RECOMMENDED MODEL*
1	Power Supply Dummy Load	5000A-compatible	Systron-Donner 9201 Test Plug-in
2	Calibration Dial	5000A-compatible	Systron-Donner 9210 (or any standard RF plug-in scale of recent manufacture)
3	Digital Voltmeter	Resolution to 1 mV at 30 Vdc (30,000 count)	Systron-Donner 7205
4	Oscilloscope	High sensitivity, variable bandwidth, differential and dual trace measurements	Tektronix 5403 mainframe with 5A22 and 5A48 vertical preamplifiers and 5B42 time base
5	Variable Transformer	0—140 V out; built-in output metering	Superior Electric VS126
6	Pulse Generator	+3 V, > 1 μs, PRF 20 ms	Systron-Donner 101C
7	Frequency/Period Counter	100 kHz	Systron-Donner 6202B

**Equipment having equivalent characteristics may be substituted*

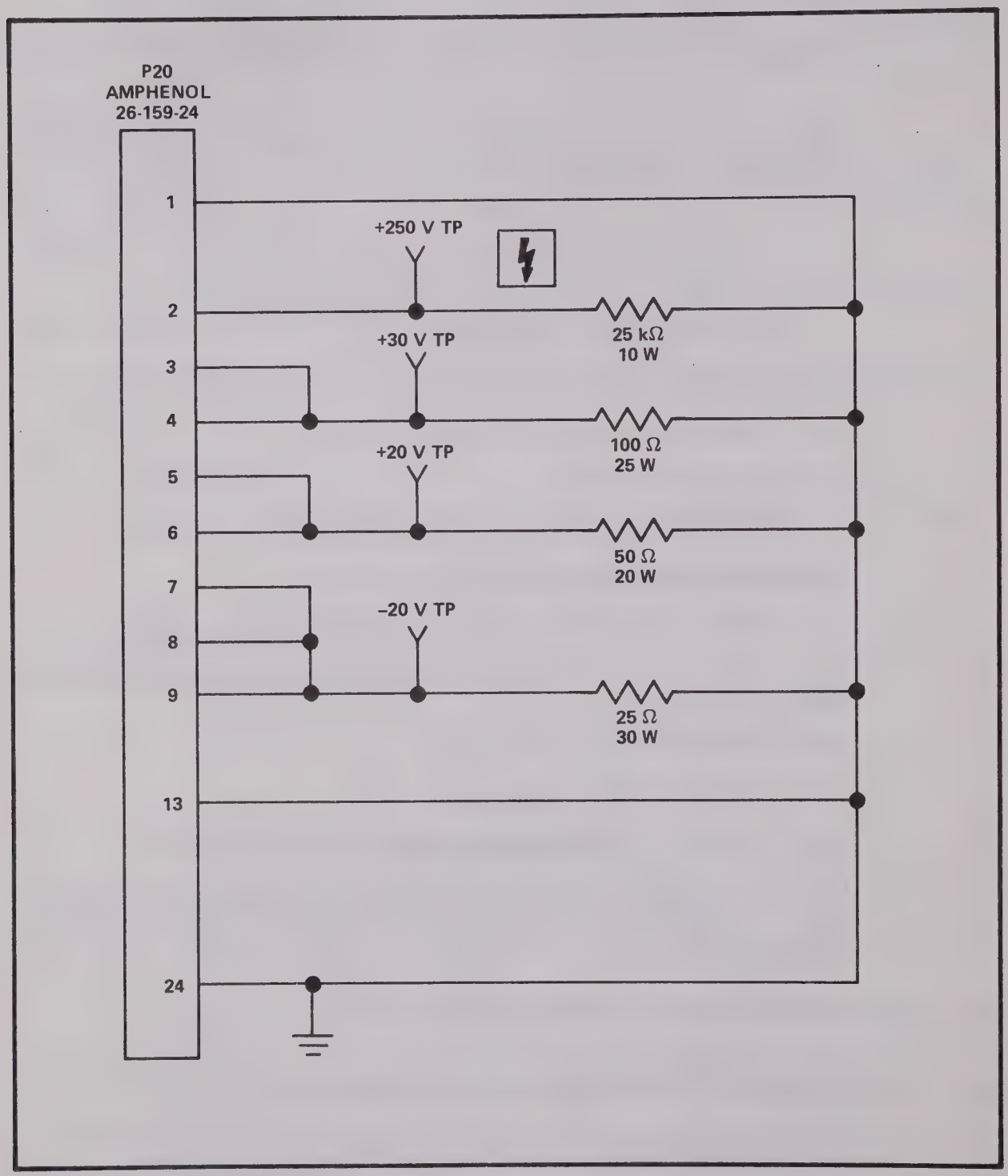


Figure 5-1. Power Supply Dummy Load Schematic Diagram

5-2.2.2 PROCEDURE.

1. Insert the test plug-in and lock it in place. If a test plug-in is not available, connect the dummy load shown in Figure 5-1 to plug-in inteface connector J20.

2. Install the calibration dial in the large rectangular cutout near the top of the sweeper. Tighten both knurled screws by turning them clockwise until they are tight. Be sure the calibration dial fits in the panel without binding.

NOTE

If a calibration dial is not available, a dial scale supplied with any standard RF plug-in may be used if it is of recent manufacture and has been supplied with a plug-in unit listed in the current Systron-Donner catalogue.

3. Set the F1—START control fully ccw.

4. Set the MARKER 2—Fc control to the center of rotation.

5. Set the F2—STOP control fully cw.

6. Set the MARKER 1 indicator to about 25% of full scale.

7. Set the MARKER 3 indicator to about 75% of full scale.

8. Set the MODE switch to CW and the Fc ± ΔF VERNIER control to CALIB.

9. Set the SWEEP SECONDS switch to .01 SECONDS and the VERNIER/MANUAL SCAN control to X1.

10. Set the VERNIER control to 0 (fully ccw).

11. Set the RECUR-TRIG-LINE switch to TRIG.

12. Set the rear-panel EXT'L SWEEP/INT'L SWEEP switch to INT'L SWEEP.

13. Determine which input voltage the 5000A has been wired for (104, 115, 208, or 230 volts). If records have not been kept, it may be necessary to determine this from the positions of the jumpers on terminal board A7 and from the position of the rear panel 115/230 volt switch.

14. Check fuse F1 to determine that it is the right value.

15. Connect the variable transformer to a line power source; set the output voltage to the appropriate value for the 5000A being tested, usually 115 volts.

16. Connect the 5000A power cord to the output connector of the variable transformer. If the PUSH ON-OFF indicator lights, press the switch to turn off the power.

5-2.3 **Power Supply Performance Checks**

5-2.3.1 DESCRIPTION. The power supply output voltages are measured under constant load and varying power line level to check accuracy and regulation.

5-2.3.2 GENERAL TEST METHOD. The procedure is written to allow measurement of power supply parameters while an extension cable is used; voltage drop in the cable wiring may cause the voltages at the points of measurement to appear to be out of specification. For this reason, the tolerances used in this procedure are somewhat relaxed. If it is desired to measure to the tolerances specified in Table 1-1, voltage measurements must be taken at the appropriate pins of interface connector J20.

Similarly, the power supply ripple measurements in this procedure are assumed to be made with a single-input oscilloscope. If comparison with the power supply ripple parameters specified in Table 1-1 is to be made, a differential input oscilloscope must be used: Connect one input to the appropriate test point, the other input to pin 1 of J20, and oscilloscope ground (chassis) to the chassis of the 5000A. The upper bandwidth limit of the oscilloscope must be 30 kilohertz or less.

Power supply measurements are made with the 5000A sweep circuits disabled; ripple measurements made with the ramp generator in operation are not valid.

The procedure is based upon a power line input level of 115 or 230 volts; if the 5000A has been wired for low-voltage inputs, make the necessary plus and minus 10 percent voltage level corrections by computation.

5-2.3.3 INITIAL SETUP.

1. Press the **PUSH ON-OFF** pushbutton; verify the indicator lights and the cooling fan runs.

2. Allow the 5000A to warm up for at least 5 minutes before proceeding.

5-2.3.4 PLUS 250 VOLT POWER SUPPLY CHECK.

1. Set the voltmeter to the 1000 Vdc range.

2. Connect the + lead of the voltmeter to J20-2 and the – lead to J20-1.

WARNING

WORK WITH CAUTION AROUND THE 250 VOLT TEST POINT. THIS OUTPUT IS POTENTIALLY LETHAL.

3. Verify the voltage is +250 ±25 Vdc.

4. Reduce the output of the variable transformer to 103.5 Vrms; verify the voltage is +250 ±40 Vdc.

5. Increase the output of the variable transformer to 126.5 Vrms; verify the voltage is +250 ±40 Vdc.

6. Set the output of the variable transformer to 115 Vrms.

7. Determine that the ripple voltage does not exceed 1.0 Vp-p.

5-2.3.5 PLUS 20 VOLT POWER SUPPLY CHECK.

1. Set the voltmeter to the 100 Vdc range.
2. Connect the + lead of the voltmeter to J20-5 and the – lead to J20-1.
3. Verify the voltage is +20 V ±25 mVdc.
4. Reduce the output of the variable transformer to 103.5 Vrms; verify the +20 V supply voltage does not change more than ±2 mV (line regulation within ±0.01%).
5. Increase the output of the variable transformer to 126.5 Vrms; verify the +20 V supply voltage does not change more than ±2 mV from the level measured in Step *3*.
6. Set the output of the variable transformer to 115 Vrms.
7. Determine that the ripple voltage does not exceed 5 mV p-p (250 μV p-p when measured differentially at an oscilloscope bandwidth of 1 Hz to 30 kHz).

5-2.3.6 MINUS 20 VOLT POWER SUPPLY CHECK.

1. Set the voltmeter to the 100 Vdc range.
2. Connect the + lead of the voltmeter to J20-8 and the – lead to J20-1.
3. Verify the voltage is –20 V ±25 mVdc.
4. Reduce the output of the variable transformer to 103.5 Vrms; verify the –20 V supply voltage does not change more than ±2 mV (line regulation within ±0.01%).
5. Increase the output of the variable transformer to 126.5 Vrms; verify the –20 V supply voltage does not change more than ±2 mV from the level measured in Step *3*.
6. Set the output of the variable transformer to 115 Vrms.
7. Determine that the ripple voltage does not exceed 5 mV p-p (250 μV p-p when measured differentially at an oscilloscope bandwidth of 1 Hz to 30 kHz).

5-2.3.7 PLUS 30 VOLT POWER SUPPLY CHECK.

1. Set the voltmeter to the 100 Vdc range.
2. Connect the + lead of the voltmeter to J20-3 and the – lead to J20-1.
3. Verify the voltage is +30 V ±125 mVdc.
4. Reduce the output of the variable transformer to 103.5 Vrms; verify the +30 V supply voltage does not change more than ±3 mV (line regulation within ± 0.01%).
5. Increase the output of the variable transformer to 126.5 Vrms; verify the +30 V supply voltage does not change more than ±3 mV from the level measured in Step *3*.
6. Set the output of the variable transformer to 115 Vrms.

7. Determine that the ripple voltage does not exceed 6 mV p-p (350 μV p-p when measured differentially at an oscilloscope bnadwidth of 1 Hz to 30 kHz).

5-2.4 Ramp Generator Performance Checks

5-2.4.1 DESCRIPTION. The output signals of the ramp generator circuits are measured to ensure conformance with amplitude, time, and linearity specifications in all modes.

5-2.4.2 SWEEP TIME CHECK.

1. Set the RECUR-TRIG-LINE switch to RECUR.
2. Connect the oscilloscope input to the 5000A front-panel SWEEP OUTPUT connector.
3. Compare the observed waveform with the one shown in Figure 5-2; determine that the waveform amplitude is 0 to +10 V.
4. Verify that the forward sweep time as shown in Figure 5-2 is 9 ±0.5 ms.
5. Verify that the retrace time is 1 ±0.2 ms.

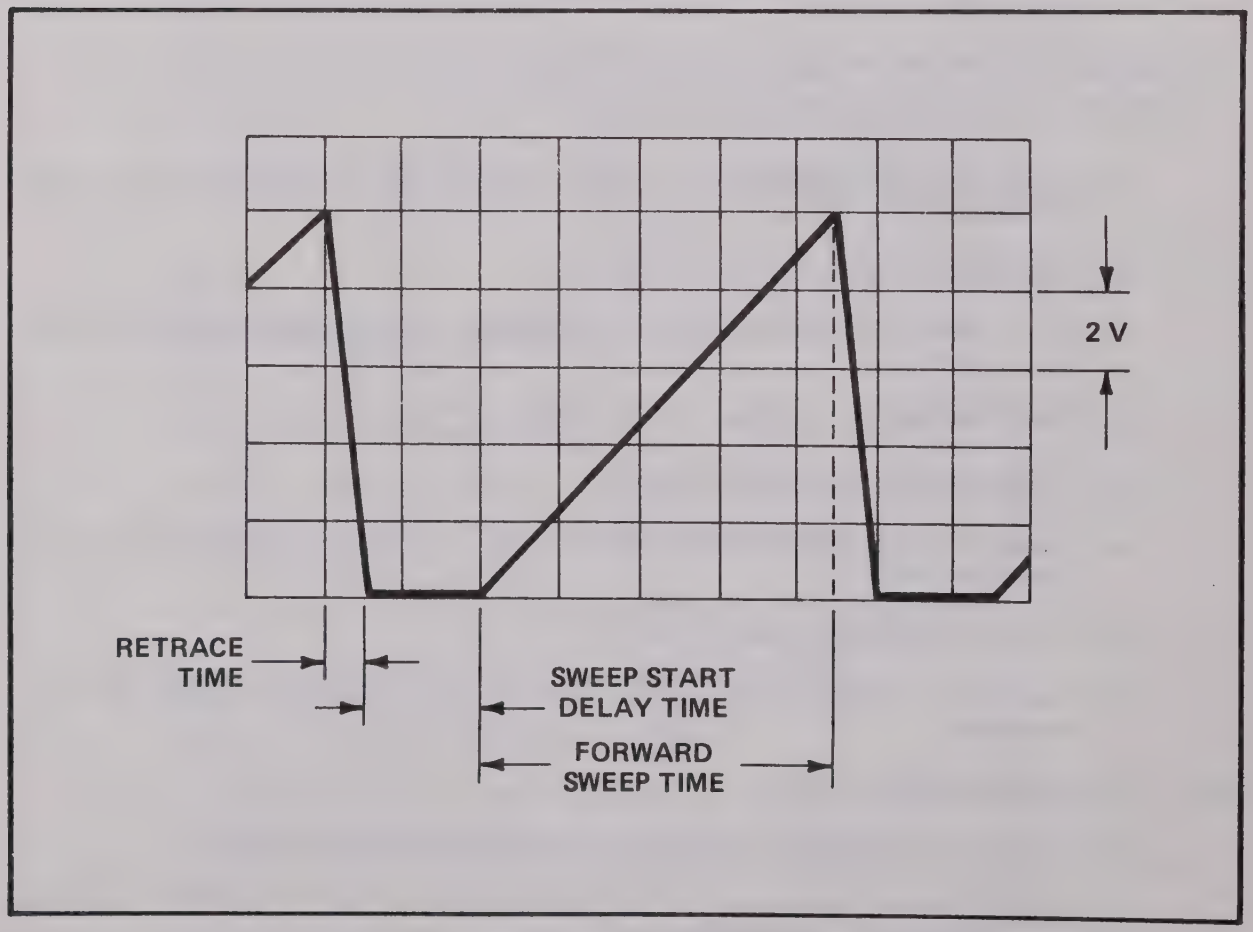


Figure 5-2. Sweep Ramp Waveform

6. Verify that the sweep start delay time is 3 ±1 ms.

7. Rotate the VERNIER/MANUAL SCAN control to X10; determine that the forward sweep time is 100 ±4 ms.

8. Verify the retrace time is 1 ±0.2 ms.

9. Set the SWEEP SECONDS switch to .1 SECONDS and the VERNIER/MANUAL SCAN control to X1.

10. Verify that the forward sweep time is 90 ±5 ms.

11. Verify that the retrace time is 10 ±2 ms.

12. Rotate the VERNIER/MANUAL SCAN control to X10 and verify that the forward sweep time is 990 ±50 ms.

13. Verify that the retrace time is 10 ±2 ms.

14. Set the SWEEP SECONDS switch to 1 SECOND and the VERNIER/MANUAL SCAN control to X1.

15. Verify that the forward sweep time is 900 ±50 ms.

16. Verify that the retrace time is 100 ±20 ms.

17. Rotate the VERNIER/MANUAL SCAN control to X10 and verify that the forward sweep time is 9.9 ±0.5 s.

18. Verify that the retrace time is 100 ±20 ms.

19. Set the SWEEP SECONDS switch to 10 SECONDS and the VERNIER/MANUAL SCAN control to X1.

20. Verify that the forward sweep time is 9 ±0.5 s.

21. Verify that the retrace time is 1 ±0.2 s.

22. Rotate the VERNIER/MANUAL SCAN control to X10 and verify that the forward sweep time is 99 ±5 s.

23. Verify that the retrace time is 1 ±0.2 s.

24. Verify the presence of the sweep waveform at the rear-panel SWEEP OUTPUT connector.

5-2.4.3 . SWEEP AMPLITUDE CHECK.

1. Connect the digital voltmeter to the unused SWEEP OUTPUT connector.

2. Set the voltmeter to measure +10 Vdc with resolution of 1 mV (+10.000 V). Adjust the gate or cycling rate to the highest speed.

3. Set the **RECUR-TRIG-LINE** switch to **TRIG.**

4. Press, then release the **MANUAL** pushbutton.

5. When the oscilloscope display shows the sweep ramp waveform at zero, measure the voltage level; it must be ±40 mV.

6. Press the **MANUAL** pushbutton to initiate the sweep ramp; read the voltage at the peak of the ramp. The voltage must be +10 V ±40 mV.

NOTE

These tests may be performed with the oscilloscope alone if sensitivity and offset range are sufficient.

7. Set the **RECUR-TRIG-LINE** switch to **RECUR**

5-2.4.4 BLANKING CHECK.

1. Set the **SWEEP SECONDS** switch to **.01 SECONDS** and the **VERNIER/MANUAL SCAN** control to **X1.**

2. Connect the second input of the dual-trace oscilloscope to the rear-panel **BLANKING OUTPUT** connector. Use the *chopped* mode to preserve timing relationships between channels.

3. Verify that the blanking pulse is present during the sweep retrace period only.

4. Verify that the blanking pulse amplitude is +19 ±1 V (–19 ±1 V for units with Option M1).

5. Set the **RECUR-TRIG-LINE** switch to **LINE.**

6 Verify the blanking pulse is present between the end of forward sweep and 3 ±1 ms before the start of the next sweep.

7. Adjust the **VERNIER/MANUAL SCAN** control to expand the sweep start delay time.

5-2.4.5 SWEEP TRIGGER CHECK.

1. Connect the oscilloscope input to the **SWEEP OUTPUT** connector.

2. Set the oscilloscope controls to display the sweep ramp.

3. Set the **RECUR-TRIG-LINE** switch to **TRIG.**

4. Let the sweep ramp cycle until it holds at 0 V.

5. Momentarily press the **MANUAL** pushbutton; verify that the sweep ramp is initiated. Repeat.

6. Connect a cable between the rear-panel **EXT'L TRIG** connector and the output of the pulse generator.

7. Set the SWEEP SECONDS switch to .01 SECONDS and the VERNIER/MANUAL SCAN control to X1.

8. Adjust the pulse generator controls to produce a positive-going pulse, +3 V peak, ≥ 1 μs wide at a PRF of 20 ms.

9. Verify the 5000A sweep initiates with each input pulse.

10. Remove the cable from the EXT'L TRIG connector.

11. Set the RECUR-TRIG-LINE switch to LINE.

12. Adjust the VERNIER/MANUAL SCAN control to vary the period between the end of sweep retrace and the beginning of the next sweep ramp; determine that this period varies between lower and upper limits of 3 to 9 ms.

5-2.4.6 MANUAL SCAN CHECK.

1. Set the SWEEP SECONDS switch to MANUAL SCAN.

2. Connect the digital voltmeter to the unused SWEEP OUTPUT connector.

3. Set the voltmeter to measure +10 Vdc with resolution of 1 mV (+10.000 V).

4. Adjust VERNIER/MANUAL SCAN control fully ccw; determine that the sweep output is +10 V ±100 mVdc.

5. Adjust VERNIER/MANUAL SCAN control fully cw; determine that the sweep output is +10 V ±100 mVdc.

5-2.5 Mode Generator Performance Check

5-2.5.1 DESCRIPTION. The mode generator, which generates and conditions the frequency reference voltage to the plug-in, is checked for dial calibration, scaling, and level accuracy.

5-2.5.2 CW MODE CHECK.

1. Connect the digital voltmeter to the rear-panel FREQ VOLT connector; set the voltmeter to measure +10 Vdc with resolution of 1 mV (+10.000 V).

2. Set the MODE control to CW.

3. Set the MARKER 2—Fc control fully ccw; determine that the output voltage is 0 ±50 mVdc.

4. Adjust the MARKER 2—Fc control so that the red dial indicator is aligned with the first mark on the 9210 calibration dial; verify that the output voltage is −100 ±60 mV.

5. Align the red indicator with the mark in the exact center of the dial; verify an output level of −5 V ±100 mV.

6. Align the red indicator with the last mark; verify an output level of −9.9 V ±60 mV.

7. Adjust the MARKER 2–Fc control fully cw and verify an output level of −10 V ±60 mV.

5-2.5.3 CW MODE NOISE CHECK.

1. Remove the digital voltmeter cable from the **FREQ VOLT** connector.
2. Attach the oscilloscope input cable to this point.
3. Set the oscilloscope for ac coupling with 100 μV/Div. sensitivity.
4. Set the oscilloscope upper bandwidth limit to 30 kHz.
5. Verify that noise does not exceed 250 μV p-p.
6. Reduce the upper bandwidth limit of the oscilloscope to 100 Hz and verify that noise does not exceed 80 μV p-p.

5-2.5.4 WIDE F1—F2 MODE CHECK.

1. Set the **MODE** switch to **WIDE F1—F2** and the **RECUR-TRIG-LINE** switch to **RECUR.**
2. Adjust the **F1—START** control fully ccw and the **F2—STOP** control fully cw.
3. Set the **SWEEP SECONDS** switch to **10 SECONDS** and the **VERNIER/MANUAL SCAN** control to **X10.**
4. Using a BNC tee connector, monitor the **FREQ VOLT** connector with the oscilloscope and the digital voltmeter.
5. Verify that the output is a negative-going ramp from 0 V ±40 mV to –10 V ±40 mV.
6. Reverse the positions of the **F1—START** and **F2—STOP** controls; verify that the output is a positive-going ramp from –10 V ±40 mV to 0 V ±40 mV.
7. Adjust the **F1—START** control so the gold indicator is aligned with the first mark on the dial.
8. Adjust the **F2—STOP** control so the orange indicator is aligned with the last mark on the dial.
9. Verify that the output ramp goes from –100 ±40 mV to –9.9 V ±40 mV.
10. Set both indicators to the center mark on the dial; verify an output of –5 V ±50 mVdc.

5-2.5.5 Fc ± ΔF MODE CHECK.

1. Set the **MODE** switch to **Fc ± ΔF x 1.**
2. Set the oscilloscope input to ac coupling; temporarily ground the input connector and center the trace.
3. Verify the displayed sweep ramp is negative-going with a p-p value of 1 V ±10 mV.
4. Verify that the sweep is symmetrical about the oscilloscope zero reference line to within ±10 mV.

5. Rotate the Fc ± ΔF VERNIER control fully ccw; verify the p-p amplitude of the displayed waveform is ≤ 10 mV.

6. Set the MODE switch to Fc ± ΔF x .1 and the Fc ± ΔF VERNIER control fully cw to CALIB.

7. Verify the displayed sweep ramp is negative-going with a p-p value of 100 ± 5 mV.

8. Set the Fc ± ΔF VERNIER control to 0 and verify the p-p amplitude of the displayed waveform is ≤ 5 mV.

9. Set the MODE switch to Fc ± ΔF x .01 and the Fc ± ΔF VERNIER control to CALIB.

10. Verify the displayed sweep ramp is negative-going with a p-p value of 10 mV ± 150 μV.

11. Set the Fc ± ΔF VERNIER control to 0 and verify the p-p amplitude of the displayed waveform is ≤ 150 μV.

5-2.6 Marker Performance Checks

5-2.6.1 DESCRIPTION. The marker outputs are checked for calibration and tracking with the mode generator outputs. This procedure should not be performed until dial calibration has been completed if the procedure of Paragraph 5-2.5 revealed the need for such calibration.

5-2.6.2 WIDE F1—F2 SWEEP MODE.

1. Set the MODE switch to WIDE F1—F2.

2. Set the F1—START control fully ccw and the F2—STOP control fully cw.

3. Set the SWEEP SECONDS switch to MANUAL SCAN.

4. Connect the oscilloscope input to the rear-panel MARKER OUTPUT jack. Set the oscilloscope controls for a free-running trace with a vertical sensitivity of 200 mV/Div. and dc coupling.

5. Connect the digital voltmeter to the FREQ VOLT jack.

6. Rotate the MARKER 2—Fc and MARKER 3 controls fully cw.

7. Adjust the MARKER 1 control so the blue frequency indicator is directly under the first marking on the 9210 calibration dial (or any standard dial scale).

8. Carefully adjust the VERNIER/MANUAL SCAN control to produce the maximum deflection of the oscilloscope trace.

9. Verify the digital voltmeter reading is –100 ±50 mVdc.

10. Verify the amplitude of the marker output is ≥ –1 V.

11. Set the MARKER 1 control to place the blue indicator directly under the center dial marking.

12. Adjust the **VERNIER/MANUAL SCAN** control for maximum deflection of the oscilloscope trace.

13. Verify the digital voltmeter reading is –5 V ±50 mVdc.

14. Adjust the **MARKER 1** control so the blue frequency indicator is directly under the last dial marking.

15. Adjust the **VERNIER/MANUAL SCAN** control to produce the maximum trace deflection.

16. Verify the voltmeter reading is –9.9 V ±50 mVdc.

17. Rotate the **MARKER 1** control fully cw.

18. Adjust the **MARKER 2–Fc** control so the red frequency indicator is directly under the first marking on the dial.

19. Carefully adjust the **VERNIER/MANUAL SCAN** control to produce the maximum deflection of the oscilloscope trace.

20. Verify the digital voltmeter reading is –100 ±50 mVdc.

21. Verify the amplitude of the marker output is ⩾ –1.2 V.

22. Set the **MARKER 2–Fc** control to place the red indicator directly under the center dial marking.

23. Adjust the **VERNIER/MANUAL SCAN** control for maximum deflection of the oscilloscope trace.

24. Verify the digital voltmeter reading is –5 V ±50 mVdc.

25. Adjust the **MARKER 2–Fc** control so the red frequency indicator is directly under the last dial marking.

26. Adjust the **VERNIER/MANUAL SCAN** control to produce the maximum trace deflection.

27. Verify the voltmeter reading is –9.9 V ±50 mVdc.

28. Rotate the **MARKER 2–Fc** control fully cw.

29. Adjust the **MARKER 3** control so the green frequency indicator is directly under the first marking on the dial.

30. Carefully adjust the **VERNIER/MANUAL SCAN** control to produce the maximum deflection on the oscilloscope trace.

31. Verify the digital voltmeter reading is –100 ±50 mVdc.

32. Verify the amplitude of the marker output is ⩾ –1 V.

33. Set the **MARKER 3** control to place the green indicator directly under the center dial marking.

34. Adjust the **VERNIER/MANUAL SCAN** control for maximum deflection of the oscilloscope trace.

35. Verify the digital voltmeter reading is –5 V ±50 mVdc.

36. Adjust the **MARKER 3** control so the green frequency indicator is directly under the last dial marking.

37. Adjust the **VERNIER/MANUAL SCAN** control to produce the maximum trace deflection.

38. Verify the voltmeter reading is –9.9 V ±50 mVdc.

5-2.6.3 Fc ± ΔF SWEEP MODE.

1. Connect the digital voltmeter to the **SWEEP OUTPUT** jack.

2. Set the **MODE** switch to **ΔF x 1**.

3. Adjust the **MARKER 1** control so the blue frequency indicator is directly under the first dial marking.

4. Adjust the **VERNIER/MANUAL SCAN** control to produce the maximum trace deflection.

5. Verify the voltmeter reading is +100 mV ±50 mVdc.

6. Adjust the **MARKER 1** control so the blue frequency indicator is directly under the center dial marking.

7. Adjust the **VERNIER/MANUAL SCAN** control for maximum trace deflection.

8. Verify the voltmeter reading is +5 V ±50 mVdc.

9. Adjust the **MARKER 1** control so the blue indicator is under the last dial marking.

10. Adjust the **VERNIER/MANUAL SCAN** control for maximum trace deflection.

11. Verify the voltmeter reading is +9.9 V ±50 mVdc.

12. Rotate the **MARKER 1** control fully cw.

13. Adjust the **MARKER 3** control so the green frequency indicator is directly under the first dial marking.

14. Adjust the **VERNIER/MANUAL SCAN** control to produce the maximum trace deflection.

15. Verify the voltmeter reading is +100 mV ±50 mVdc.

16. Adjust the **MARKER 3** control so the green frequency indicator is directly under the center dial marking.

17. Adjust the **VERNIER/MANUAL SCAN** control for maximum trace deflection.

18. Verify the voltmeter reading is +5 V ±50 mVdc.

19. Adjust the **MARKER 3** control so the green indicator is under the last dial marking.

20. Adjust the **VERNIER/MANUAL SCAN** control for maximum trace deflection.

21. Verify the voltmeter reading is +9.9 V ±50 mVdc.

5-3. CALIBRATION

5-3.1 General

This paragraph contains instructions for calibrating the internal circuitry of the Model 5000A; these procedures are listed in Table 5-3. Recalibration is necessary after parts have been replaced or when periodic performance checks reveal out-of-tolerance conditions.

5-3.2 Equipment Required for Calibration

Table 5-4 lists items of test equipment required for calibration of the 5000A Sweeper Mainframe.

5-3.3 Location of Components and Adjustments

As an aid to calibration and repair, the locations of major components and subassemblies are shown in Figure 5-3. All electrical adjustment parts used in the 5000A are fixed-value resistors or capacitors selected to produce in-specification voltages, currents, or signals. The location of each adjustment component is shown in a printed-circuit board drawing within the appropriate calibration procedure.

5-3.4 General Procedure for Selection of Component Values

Paragraphs 5-3.5 through 5-3.7, following, contain test procedures which require the selection of fixed-value components to accomplish a particular calibration goal. These procedures may be completed more easily if simple practices are followed:

1. When a calibration resistor is removed and replaced with a resistance substitution box, it is generally best to cut the fixed resistor out of the circuit next to the body of the resistor. Use the resistor leads as connecting points for test leads from the resistance substitution box. This will avoid stressing the printed circuit board material and traces with repeated soldering/desoldering operations.

2. When determining resistance value with a decade box or resistance substitution box, always set the decade box value to a standard resistance value. Do not cause yourself unnecessary trouble by calibrating to unavailable component values.

3. Where two select-by-test calibration resistors are wired in parallel, one is used as a "trimming" value for the other. It is expected that one of the resistors will be set to a relatively low value (in terms of the other resistor) and the parallel resistance will be relatively high in value. Again, only standard resistance values should be used in this situation, although the resulting resistance value in the circuit of the two components will probably not be a standard value.

Table 5-3. Calibration Procedures

FUNCTION	CONTROL OR COMPONENT	LOCATION	REFERENCE PARAGRAPH
+20 V Power Supply	R6, R8, R19	A5	5-3.5.1, 5-3.5.2
–20 V Power Supply	R16, R18, R12	A5	5-3.5.1, 5-3.5.3
+30 V Power Supply	R4	A6	5-3.5.1, 5-3.5.4
External/Manual/Line Trigger Zero	R7	A9	5-3.6.1, 5-3.6.2
Recurrent Trigger Zero	R9	A9	5-3.6.1, 5-3.6.3
Sweep Ramp Amplitude	R28, R29	A2	5-3.6.1, 5-3.6.4
Sweep Start Delay	R17	A2	5-3.6.1, 5-3.6.5
Manual Scan	R4, R6	A9	5-3.6.1, 5-3.6.6
F1-F2 and ΔF Input Offset	R4	A8	5-3.7.1, 5-3.7.2
ΔF Offset and Gain	R19, R21, R23, R24	A8	5-3.7.1, 5-3.7.3
F1-Start Dial Calibration	R25	A12	5-3.8.1, 5-3.8.2
F2-Stop Dial Calibration	R12	A12	5-3.8.1, 5-3.8.3
Marker 2-Fc Dial Calibration	R26	A12	5-3.8.1, 5-3.8.4
Marker 1 Dial Calibration	R14	A12	5-3.8.1, 5-3.8.5
Marker 3 Dial Calibration	R16	A12	5-3.8.1, 5-3.8.6

Table 5-4. Test Equipment Required for Calibration

ITEM	TYPE OF EQUIPMENT	CHARACTERISTICS	RECOMMENDED MODEL*
1	Digital Voltmeter	Resolution to 1 mV at 30 Vdc (30,000 count)	Systron-Donner 7205
2	Variable Power Supply Load	0 to 1.2 A dc, 0 to 30 Vdc	Transistor Devices, Inc. Model DLR-50-15-150
3	Decade Resistance Box	1 Ω to 1 MΩ ±1%	Heathkit IN-3117 (4 required)
4	Oscilloscope	High sensitivity with ±10 Vdc offset	Tektronix 5403 mainframe with 5A13N vertical preamplifier and 5B40 time base
5	Calibration Dial	5000A-compatible	Systron-Donner 9210 (or any standard RF plug-in scale of recent manufacture)

**Equipment of equivalent characteristics may be subsituted*

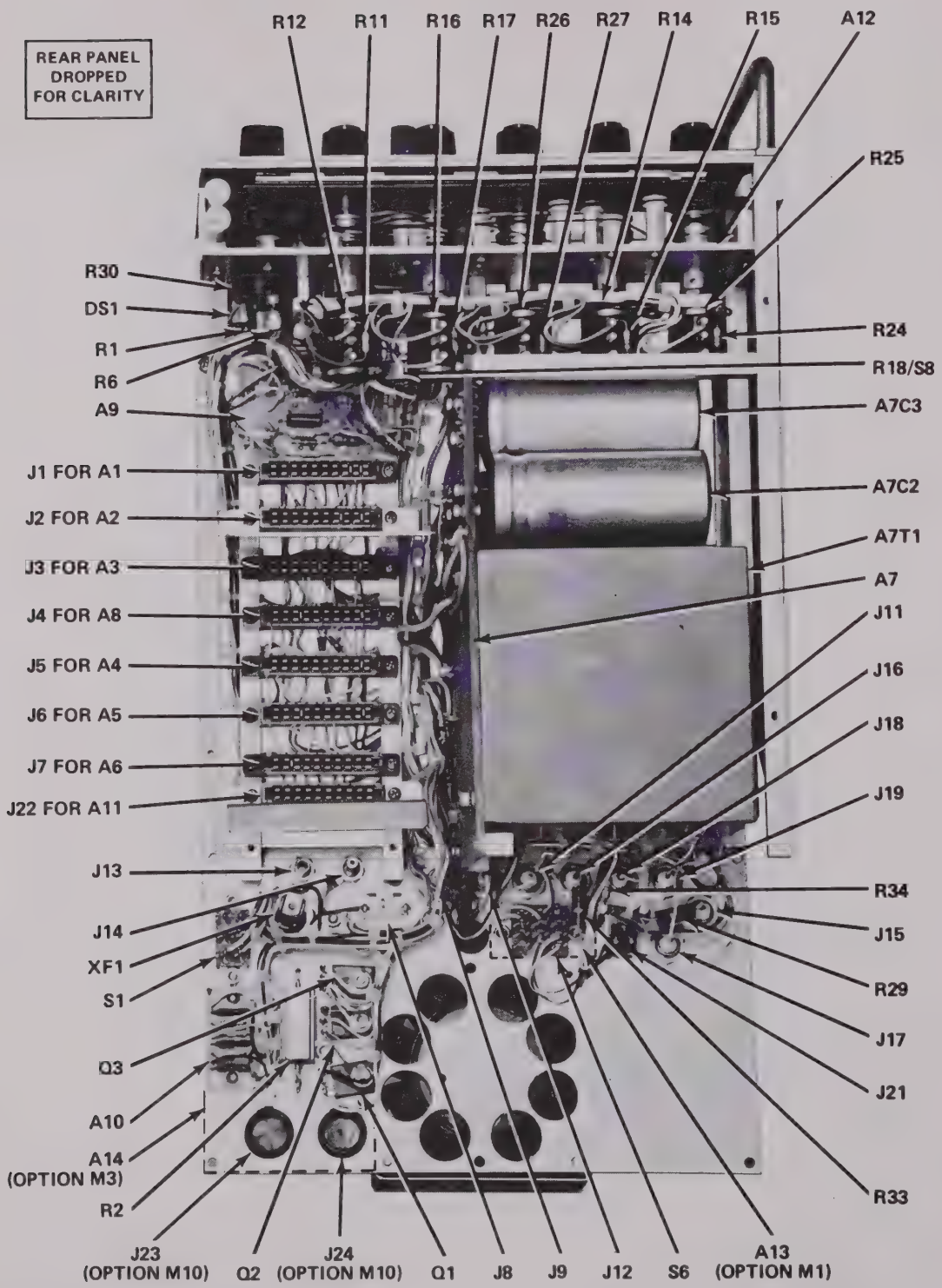


Figure 5-3. Location of Components, Adjustments, and Reference Test Points (Sheet 1 of 4)

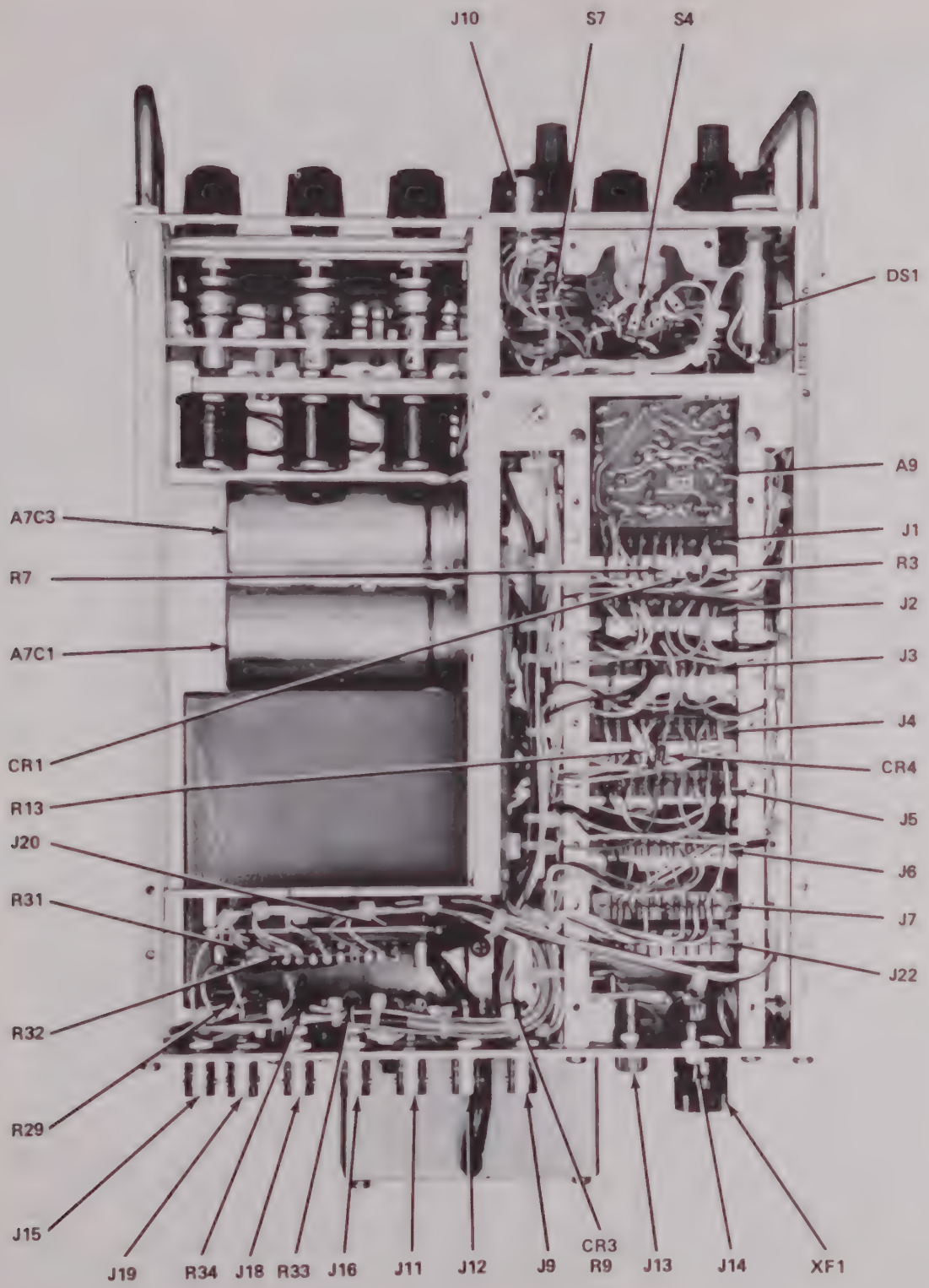


Figure 5-3. Location of Components, Adjustments, and Reference Test Points (Sheet 2 of 4)

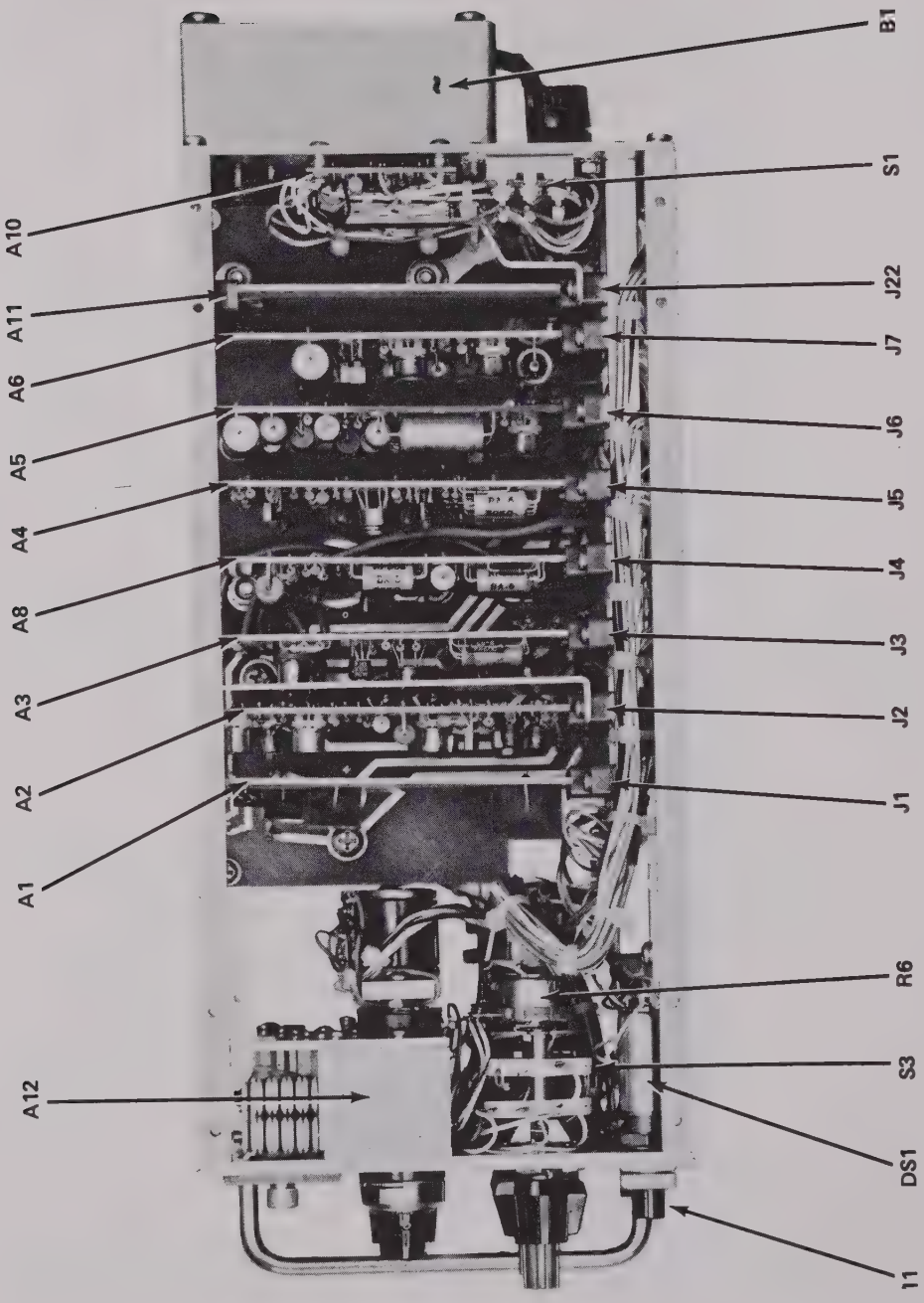


Figure 5-3. Location of Components, Adjustments, and Reference Test Points (Sheet 3 of 4)

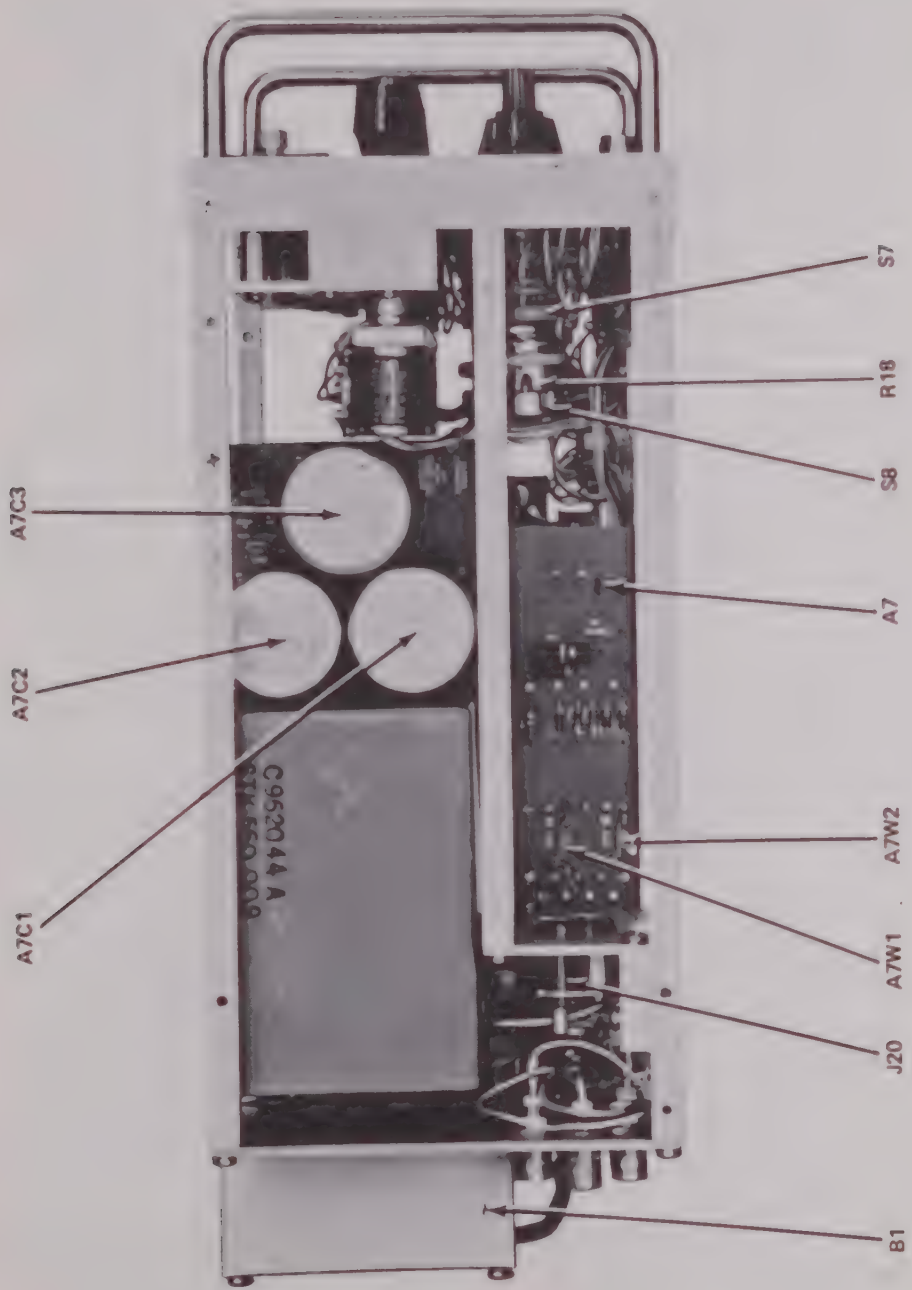


Figure 5-3. Location of Components, Adjustments, and Reference Test Points (Sheet 4 of 4)

5-3.5 Power Supply Calibration

Perform the power supply calibration procedures in the order indicated. If only the minus 20 volt power supply is out of calibration, that supply may be calibrated individually by following the applicable procedure in Paragraph 5-3.5.3. If the plus 20 volt supply requires recalibration, all supplies must be recalibrated. No voltage calibration components are provided for the plus 30 volt supply: if the output of the plus 20 volt supply is within specification limits and the plus 30 volt output is not, corrective maintenance is required (Section VI).

5-3.5.1 INITIAL PROCEDURES.

1. Remove any RF, current supply, or test plug-in from the 5000A.
2. Disconnect the power cord at the rear-panel **LINE** connector.
3. Remove the top cover of the 5000A by removing four No. 6-32 x 5/16 in. flat-head Phillips screws (Item 184 of Figure 7-1).
4. Remove the bottom cover by removing four No. 6-32 x 5/16 in. truss-head Phillips screws (Item 191 of Figure 7-1).
5. Remove all eight plug-in printed circuit assemblies from the 5000A.
6. Measure the power line voltage in the area where the 5000A is used. Check the value of Fuse F1, the position of **115/230 V** switch S1, and the positions of jumper wires A7W1 and A7W2. Make any necessary modifications. (Refer to Paragraph 2-2.2, Section II, if the jumper wires are not set for the nominal line voltage.)

WARNING

WORK WITH CAUTION IN ALL FOLLOWING PROCEDURES. YOU ARE EXPOSED TO POTENTIALLY LETHAL VOLTAGES WHEN THE BOTTOM COVER IS REMOVED.

7. Connect the power cord to the **LINE** connector.
8. Check the **PUSH ON-OFF** indicator; if it is lighted, press the pushbutton to turn power off.

5-3.5.2 PLUS 20 VOLT POWER SUPPLY.

1. Connect the + lead of the digital voltmeter to J20-5 and the – lead to J20-1.
2. Remove resistor A5R6 (refer to Figure 5-4) and connect a resistance decade box in its place. Set the resistance value to match that of the resistor removed.
3. Remove resistor A5R8 (refer to Figure 5-4) and connect a resistance decade box in its place. Set the resistance value to match that of the resistor removed.
4. Insert Extender Assembly A11 in connector J6 (refer to Figure 5-3).

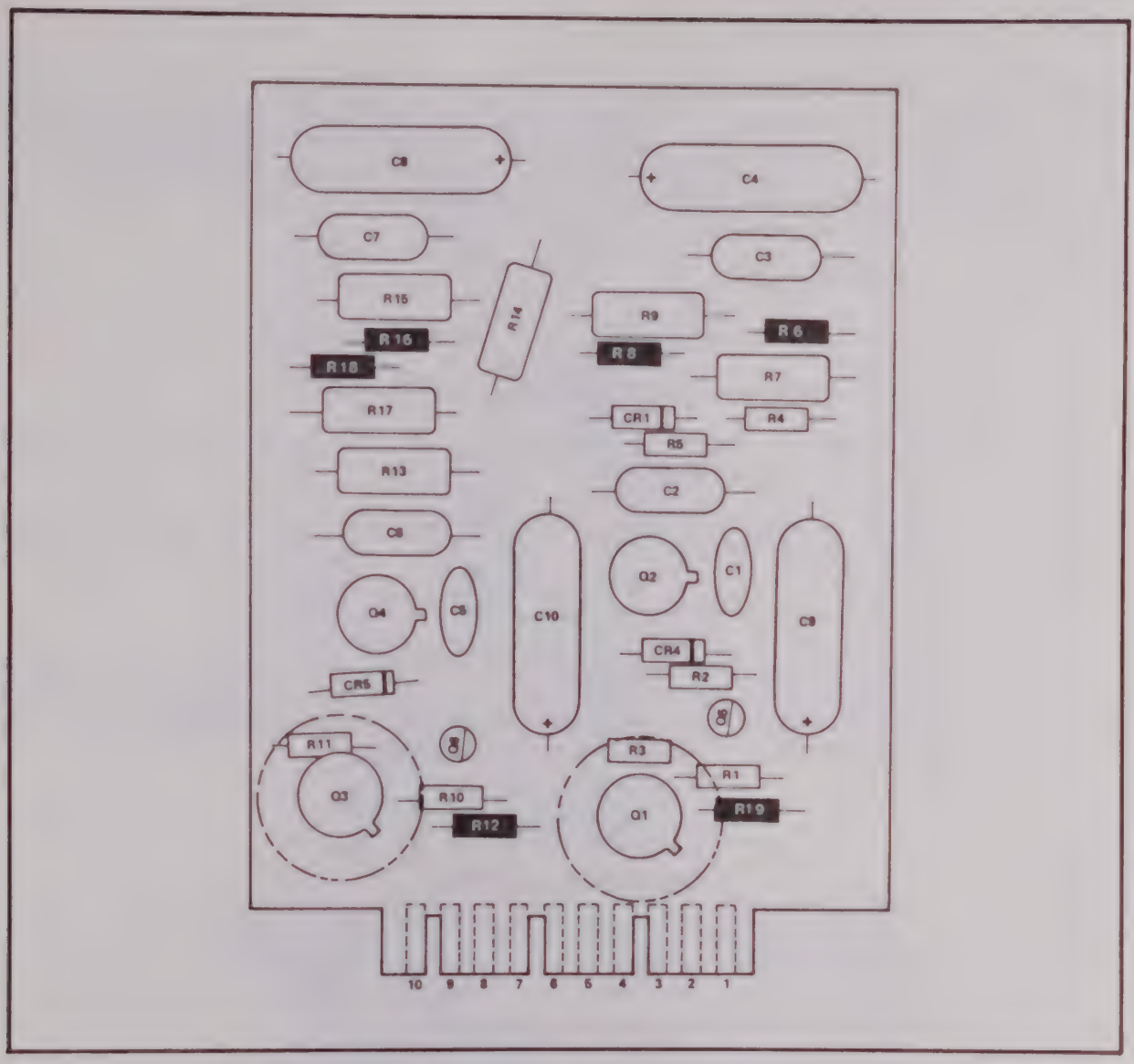


Figure 5-4. A5 Board Calibration Component Location

5. Insert printed circuit assembly A5 in the mating connector of A11 so that the component side of the board faces the front of the 5000A.

6. Press the **PUSH ON-OFF** switch to turn on power.

7. Allow the digital voltmeter and 5000A to warm up completely — at least 15 minutes.

8. Select standard resistance values for A5R6 and A5R8 which produce a voltmeter reading of +20.000 Vdc; the maximum allowable deviation is ±0.020 Vdc.

9. Turn off 5000A power.

NOTE

Complete Steps *10* through *16* if a variable power supply load is available. If this device is not available, proceed to Step *17*.

10. Connect the variable power supply load between J20-6 and J20-1. Leave the digital voltmeter connected to J20-5 and J20-1.

11. Set the load for minimum current, then press the **PUSH ON-OFF** switch to turn on power.

12. Slowly increase the load current to 1 A; continue to increase the load current while monitoring the current indicator in the variable load. Note the current level where the output voltage of the +20 V supply drops to zero.

13. If the current limit is set for 1.2 A ±0.1 A, no adustment is necessary. Verify the power supply voltage is +20 ±0.020 Vdc at the 1.2 ±0.1 A level. Readjust A5R6 and A5R8 as required to maintain the specified ±0.01% load regulation. Proceed to Step *17*.

14. If adjustment of the current limit is required, turn off power and connect a resistance decade box in place of resistor A5R19. Set the resistance value to 910 Ω initially.

15. Turn power on. Select a standard resistance value for A5R19 which sets the current limit to 1.2 ±0.1 A as the variable load is increased from minimum to maximum.

16. Verify the power supply voltage is +20 ±0.020 Vdc at the 1.2 ±0.1 A level. Readjust A5R6 and A5R8 as required to maintain the specified ±0.01% load regulation.

17. Turn off power and remove the A5 board.

18. Pick the standard resistor value closest to the decade box resistance settings for A5R6, A5R8, and A5R19 (if a new value for A5R19 was selected). The resistors must have the following characteristics:

    a. Metal film construction

    b. Tolerance of ±2%

    c. Wattage rating of ¼ W

    d. Temperature coefficient of ±9 PPM or less

19. Permanently solder the selected resistors in place.

5-3.5.3 MINUS 20 VOLT POWER SUPPLY.

1. Connect the + lead of the digital voltmeter to J20-8 and the – lead to J20-1.

2. Remove resistor A5R16 (refer to Figure 5-4) and connect a resistance decade box in its place. Set the resistance value to match that of the resistor removed.

3. Remove resistor A5R18 (refer to Figure 5-4) and connect a resistance decade box in its place. Set the resistance value to match that of the resistor removed.

4. Insert Extender Assembly A11 in connector J6 (refer to Figure 5-3).

5. Insert printed circuit assembly A5 in the mating connector of A11 so that the component side of the board faces the front of the 5000A.

6. Press the PUSH ON-OFF switch to turn on power.

7. Allow the digital voltmeter and 5000A to warm up completely — at least 15 minutes if the power has been off more than 5 minutes.

8. Select standard resistance values for A5R16 and A5R18 which produce a voltmeter reading of −20.000 Vdc; the maximum allowable deviation is ±0.020 Vdc.

9. Turn off 5000A power.

NOTE

Complete Steps *10* through *16* if a variable power supply load is available. If this device is not available, proceed to Step *17*.

10. Connect the variable power supply load between J20-7 and J20-1. Leave the digital voltmeter connected to J20-8 and J20-1.

11. Set the load for minimum current, then press the PUSH ON-OFF switch to turn on power.

12. Slowly increase the load current to 1 A; continue to increase the load current while monitoring the current indicator in the variable load. Note the current level where the output voltage of the −20 V supply drops to zero.

13. If the current limit is set for 1.2 A ±0.1 A, no adjustment is necessary. Verify the power supply voltage is −20 ±0.020 Vdc at the 1.2 ±0.1 A level. Readjust A5R16 and A5R18 as required to maintain the specified ±0.01% load regulation. Proceed to Step *17*.

14. If adjustment of the current limit is required, turn off power and connect a resistance decade box in place of resistor A5R12. Set the resistance value to 820 Ω initially.

15. Turn power on. Select a standard resistance value for A5R12 which sets the current limit to 1.2 ±0.1 A as the variable load is increased to maximum.

16. Verify the power supply voltage is −20 ±0.020 Vdc at the 1.2 ±0.1 A level. Readjust A5R16 and A5R18 as required to maintain the specified ±0.01% load regulation.

17. Turn off power and remove the A5 board.

18. Pick the standard resistor values closest to the decade box settings for A5R16, A5R18, and A5R12 (if a new value for A5R12 was selected). The resistors must have the following characteristics:

    a. Metal film construction
    b. Tolerance of ±2%
    c. Wattage rating of ¼ W
    d. Temperature coefficient of ±9 PPM or less

19. Permanently solder the selected resistors in place.

20. Remove the A11 Extender Assembly from J6.

21. Install Dual Precision Regulator Assembly A5 in J6.

5-3.5.4 PLUS 30 VOLT POWER SUPPLY. The plus 30 volt power supply output voltage does not require calibration. If a variable power supply load is available, the current limit of the supply may be calibrated using the following procedure:

1. Insert Extender Assembly A11 in connector J7 (refer to Figure 5-3).

2. Connect the + lead of the digital voltmeter to J20-3 and the – lead to J20-1.

3. Connect the variable power supply load between J20-4 and J20-1.

4. Insert printed circuit assembly A6 in the mating connector of A11 so that the component side of the board faces the front of the 5000A.

5. Set the load for minimum current, then press the **PUSH ON-OFF** switch to turn on power.

6. Slowly increase the load current to 700 mA; continue to increase the load current while monitoring the current indicator in the variable load. Note the current level where the output voltage of the +30 V supply drops to zero.

7. If the current limit is set for 800 ±50 mA, no adjustment is necessary. Proceed to Paragraph 5-3.5.5.

8. If adjustment of the current limit is required, turn off power and connect a resistance decade box in place of resistor A6R4 (Figure 5-5). Set the resistance value to 560 Ω initially.

9. Turn power on.

10. Select a standard resistance value for A6R4 which sets the current limit to 800 ±50 mA as the variable load is increased from minimum to maximum.

11. Turn off power and remove the A6 board.

12. Pick the standard resistor value closest to the decade box setting for A6R4. The resistor must have the following characteristics:
    a. Metal film construction
    b. Tolerance of ±2%
    c. Wattage rating of ¼ W
    d. Temperature coefficient of ±9 PPM or less

13. Permanently solder the selected resistor in place.

14. Remove A11 Extender Assembly from J7.

15. Install Single Precision Regulator Assembly A6 in J7.

16. Re-install printed circuit assemblies A1, A2, A3, A4, and A8.

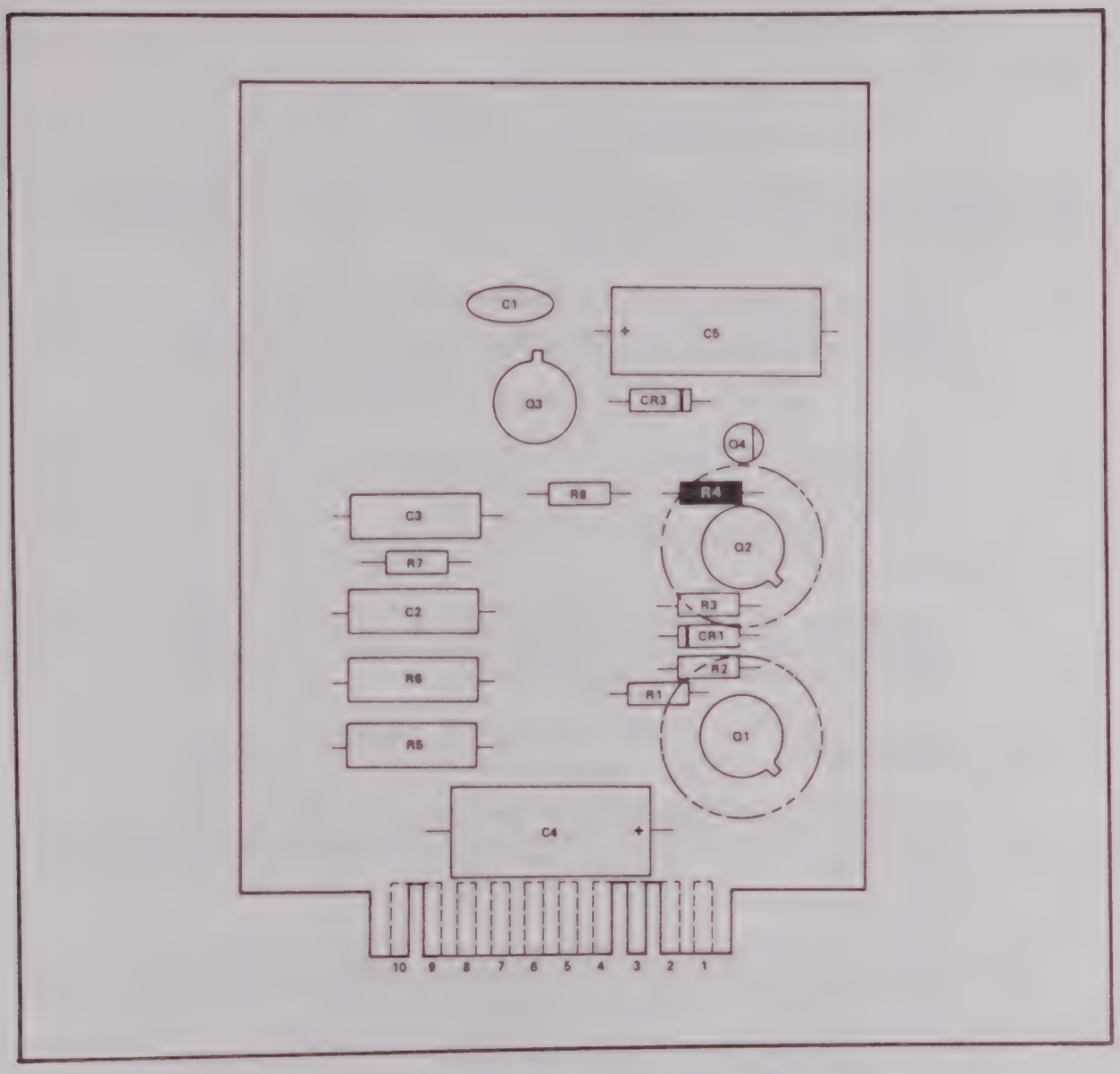


Figure 5-5. A6 Board Calibration Component Location

5-3.6 Ramp Generator Calibration

The ramp generator calibration procedures may be performed individually or in any desired order (after 5-3.6.1); the order in which they are presented is optimum if a complete recalibration of the ramp generator is required following component replacement:

5-3.6.1 INITIAL PROCEDURES.

1. Remove any RF, current supply, or test plug-in from the 5000A.
2. Disconnect the power cord at the rear-panel **LINE** connector.

3. Remove the top cover of the 5000A by removing four No. 6-32 x 5/16 in. flat-head Phillips screws (Item 184 of Figure 7-1).

4. Remove the bottom cover by removing four No. 6-32 x 5/16 in. truss-head Phillips screws (Item 191 of Figure 7-1).

5. Install printed circuit assemblies A1, A5, and A6. Remove printed circuit assemblies A2, A3, A8, and A4.

WARNING

WORK WITH CAUTION IN ALL FOLLOWING PROCEDURES. YOU ARE EXPOSED TO POTENTIALLY LETHAL VOLTAGES WHEN THE BOTTOM COVER IS REMOVED.

6. Set the **MODE** switch to **WIDE F1–F2**.

7. Set the **SWEEP SECONDS** switch to **1 SECONDS** and the **VERNIER/MANUAL SCAN** control to the center of its rotation.

8. Check the rear-panel **EXT'L SWEEP/INT'L SWEEP** switch; it must be set to **INT'L SWEEP**.

9. Reconnect the power cord to the rear-panel **LINE** connector. Do not turn power on at this time.

5-3.6.2 EXTERNAL/MANUAL/LINE TRIGGER ZERO.

1. Insert Trigger-Sweep assembly A2 in J2.

2. Connect a cable from the front-panel **SWEEP OUTPUT** connector to the input of the digital voltmeter; set the DVM to its 10 V range.

3. Remove resistor A9R7 (refer to Figure 5-6) and connect a resistance decade box in its place. Set the resistance value to 100 kΩ. (It may be necessary to connect two decade boxes in series to obtain sufficient resistance range.)

4. Turn on voltmeter and 5000A power; allow both instruments to stabilize for at least 15 minutes.

5. Set the **RECUR-TRIG-LINE** switch to **TRIG**.

6. Select a standard resistance value for A9R7 which produces a voltmeter reading of zero; the maximum allowable deviation is ±20 mVdc.

7. Turn off power and disconnect the decade box(es).

8. Pick the standard resistance value closest to the decade box setting for A9R7. The resistor must have the following characteristics:

   a. Metal film construction

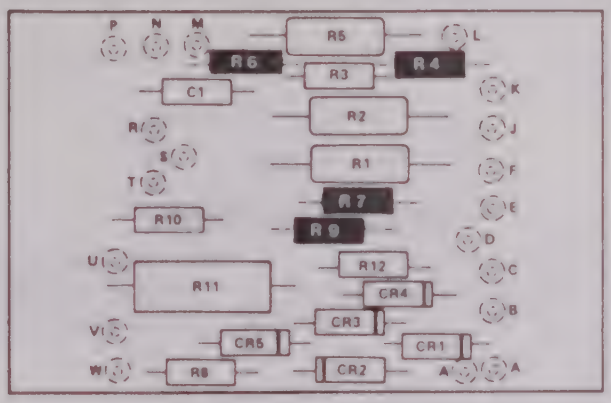


Figure 5-6. A9 Board Calibration Component Location

b. Tolerance of ±2%

c. Wattage rating of ¼ W

d. Temperature coefficient of ±9 PPM or less

9. Permanently solder the selected resistor in place.

5-3.6.3 RECURRENT TRIGGER ZERO.

1. Insert Trigger-Sweep assembly A2 in J2.

2. Connect a cable from the front-panel **SWEEP OUTPUT** connector to the input of the oscilloscope.

3. Remove resistor A9R9 (refer to Figure 5-6) and connect a resistance decade box in its place. Set the resistance value to 430 Ω.

4. Turn on oscilloscope and 5000A power; allow both instruments to stabilize for at least 15 minutes.

5. Set the **RECUR-TRIG-LINE** switch to **RECUR**.

6. Set the **SWEEP SECONDS** switch to **.01 SECONDS** and the **VERNIER/MANUAL SCAN** control to **X1**.

7. Set the vertical sensitivity of the oscilloscope preamplifier to 10 mV/Div. Carefully establish a zero reference line on the center Y-axis graticule line.

8. Select a standard resistance value for A9R9 which produces a sweep voltage of 0 ±20 mV during sweep start delay time (refer to Figure 5-2).

9. Turn off power and disconnect the decade box.

10. Pick the standard resistance value closest to the decade box setting for A9R9. The resistor must have the following characteristics:

    a. Metal film construction

    b. Tolerance of ±2%

    c. Wattage rating of ¼ W

    d. Temperature coefficient of ±9 PPM or less

11. Permanently solder the selected resistor in place.

5-3.6.4 SWEEP RAMP AMPLITUDE.

1. Remove resistor A2R28 (refer to Figure 5-7) and connect a resistance decade box in its place. Set the resistance value to match that of the resistor removed.

2. Remove resistor A2R29 and connect a resistance decade box in its place. Set the resistance value to match that of the resistor removed.

3. Insert Extender Assembly A11 in J2 (refer to Figure 5-3).

4. Insert printed circuit assembly A2 in the mating connector of A11 so that the component side of the board faces the front of the 5000A.

5. Turn on oscilloscope and 5000A power; allow both instruments to stabilize for at least 15 minutes.

6. Connect a cable from the front-panel **SWEEP OUTPUT** connector to the input of the oscilloscope.

7. Carefully establish a +10 V reference line on the center Y-axis graticule line of the oscilloscope.

NOTE

If the oscilloscope is not equipped with an internal voltage reference offset or does not have 10 V offset capability at a sensitivity of 10 mV/Div, an external offset voltage reference of −10 V ±2 mVdc must be connected to the negative input of the differential preamplifier.

8. Set the **RECUR-TRIG-LINE** switch to **RECUR**.

9. Set the **SWEEP SECONDS** switch to **.01 SECONDS** and the **VERNIER/MANUAL SCAN** control to **X1**.

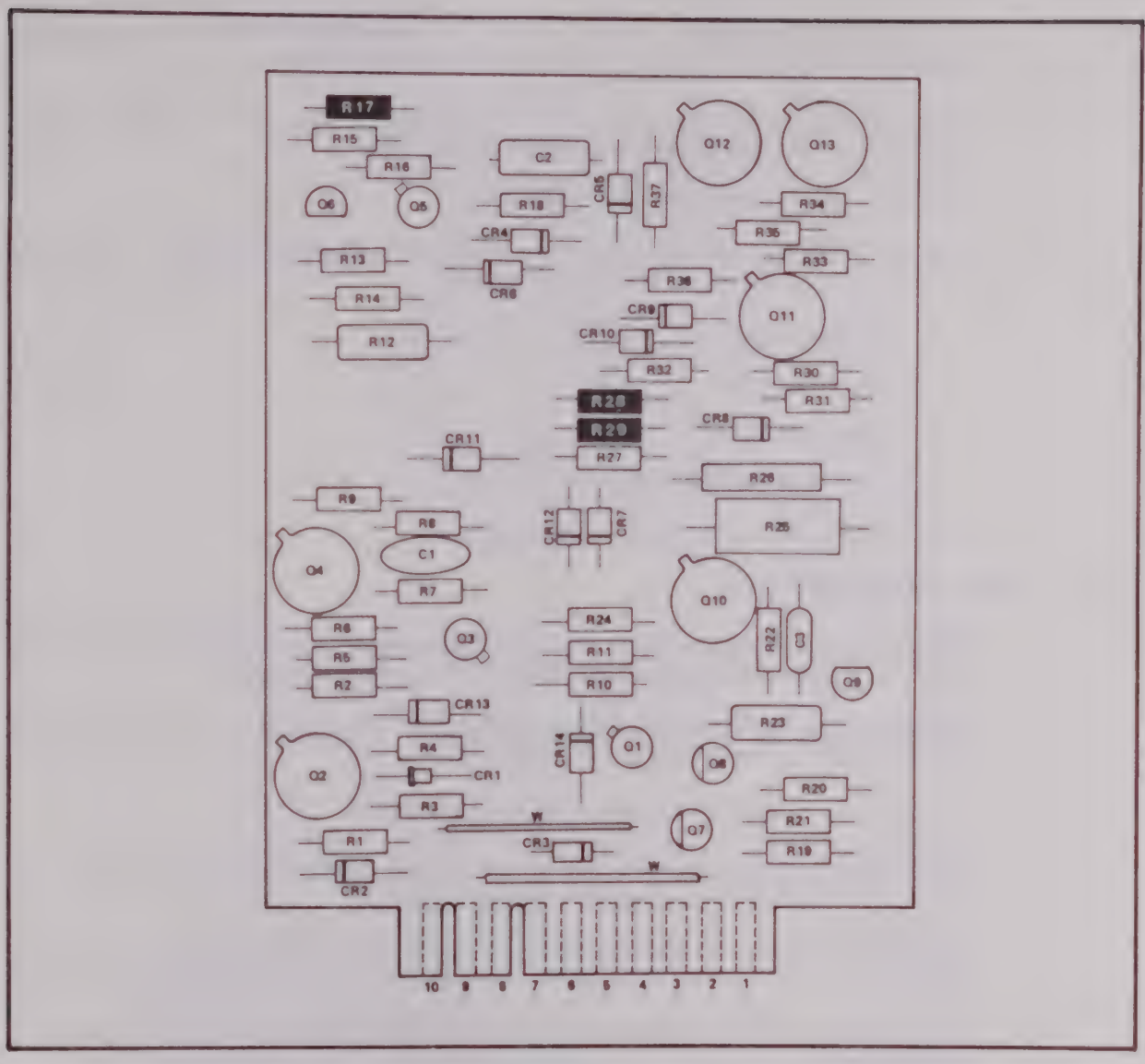


Figure 5-7. A2 Board Calibration Component Location

10. Adjust the oscilloscope to trigger on the peak positive voltage.
11. Select standard resistance values for A2R28 and A2R29 which produce a sweep voltage of +10 V ±20 mV at the positive peak of forward sweep time (Figure 5-2).
12. Turn off power and disconnect the decade boxes.
13. Pick the standard resistor values closest to the decade box resistance settings for A2R28 and A2R29. The resistors must have the following characteristics:
    a. Metal film construction
    b. Tolerance of ±2%
    c. Wattage rating of ¼ W
    d. Temperature coefficient of ±9 PPM or less
14. Permanently solder the selected resistors in place.

5-3.6.5 SWEEP START DELAY.

1. Remove resistor A2R17 (refer to Figure 5-7) and connect a resistance decade box in its place. Set the resistance value to match that of the resistor removed.

2. Insert Extender Assembly A11 in connector J2 (refer to Figure 5-3).

3. Insert printed circuit assembly A2 in the mating connector of A11 so that the component side of the board faces the front of the 5000A.

4. Turn on oscilloscope and 5000A power; allow both instruments to stabilize for at least 15 minutes.

5. Connect a cable from the front-panel **SWEEP OUTPUT** connector to the input of the oscilloscope.

6. Set the **RECUR-TRIG-LINE** switch to **RECUR**.

7. Set the **SWEEP SECONDS** switch to **.01 SECONDS** and the **VERNIER/MANUAL SCAN** control to **X1**.

8. Set the time base of the oscilloscope to 1 ms/Div.

9. Set the vertical preamplifier of the oscilloscope to 2 V/Div.

10. Trigger the oscilloscope on the trailing edge of sweep retrace time (Figure 5-2). If difficulty is experienced, trigger the oscilloscope externally from the 5000A **BLANKING OUTPUT** connector.

11. Select a standard resistance value for A2R17 which produces a sweep start delay period of 3 ms; the maximum allowable deviation is ±1 ms.

12. Turn off power and disconnect the decade box.

13. Pick the standard resistor value closest to the decade box resistance setting for A2R17. The resistor must have the following characteristics:

    a. Metal film construction

    b. Tolerance of ±2%

    c. Wattage rating of ¼ W

    d. Temperature coefficient of ±9 PPM or less

14. Permanently solder the selected resistor in place.

5-3.6.6 MANUAL SCAN.

1. Insert Trigger-Sweep Assembly A2 in J2.

2. Connect a cable from the front-panel **SWEEP OUTPUT** connector to the input of the digital voltmeter; set the DVM to its 10 V range.

3. Remove resistor A9R4 (refer to Figure 5-6) and connect a resistance decade box in its place. Set the resistance value to match that of the resistor removed.

4. Remove resistor A9R6 (refer to Figure 5-6) and connect a resistance decade box in its place. Set the resistance value to match that of the resistor removed.

5. Turn on voltmeter and 5000A power; allow both instruments to stabilize for at least 15 minutes.

6. Set the SWEEP SECONDS switch to MANUAL SCAN.

7. Rotate the VERNIER/MANUAL SCAN control to full ccw rotation.

8. Select a standard resistance value for A9R4 which produces a voltmeter reading of zero; the maximum allowable deviation is ±50 mVdc.

9. Rotate the VERNIER/MANUAL SCAN control fully cw.

10. Select a standard resistance value for A9R6 which produces a voltmeter reading of +10 V ±100 mVdc.

11. Repeat Steps 7 through *10* as many times as necessary to ensure that the manual scan minimum and maximum voltages are within the specified tolerances. Be sure to use only standard resistance values for A9R4 and A9R6

12. Turn off power and disconnect the decade box(es).

13. Pick the standard resistance values closest to the decade box settings for A9R4 and A9R6. The resistors must have the following characteristics:

    a. Metal film construction

    b. Tolerance of ±2%

    c. Wattage rating of ¼ W

    d. Temperature coefficient of ±9 PPM or less

14. Permanently solder the selected resistors in place.

5-3.7 Mode Generator Calibration

Perform the procedures in the order indicated.

5-3.7.1 INITIAL PROCEDURES.

1. Remove any RF, current supply, or test plug-in from the 5000A.

2. Disconnect the power cord at the rear-panel LINE connector.

3. Remove the top cover of the 5000A by removing four No. 6-32 x 5/16 in. flat-head Phillips screws (Item 184 of Figure 7-1).

4. Remove the bottom cover by removing four No. 6-32 x 5/16 in. truss-head Phillips screws (Item 191 of Figure 7-1).

5. Install printed circuit assemblies A1, A2, A5, and A6. Remove printed circuit assemblies A3, A8, and A4.

WARNING

WORK WITH CAUTION IN ALL FOLLOWING PROCEDURES. YOU ARE EXPOSED TO POTENTIALLY LETHAL VOLTAGES WHEN THE BOTTOM COVER IS REMOVED.

6. Check the rear-panel **EXT'L SWEEP/INT'L SWEEP** switch; it must be set to **INT'L SWEEP.**

7. Reconnect the power cord to the rear-panel **LINE** connector. Do not turn power on at this time.

5-3.7.2 F1—F2 AND ΔF INPUT OFFSET.

1. Set the **MODE** switch to **WIDE F1—F2.**

2. Set the **SWEEP SECONDS** switch to **.01 SECONDS** and the **VERNIER/MANUAL SCAN** control to **X1.**

3. Set the **VERNIER** control to **0,** fully ccw.

4. Set the **RECUR-TRIG-LINE** switch to **RECUR.**

5. Remove resistor A8R4 (refer to Figure 5-8) and connect a resistance decade box in its place. Set the resistance value to match that of the resistor removed.

6. Insert Extender Assembly A11 in J4.

7. Insert printed circuit assembly A8 in the mating connector of A11 so the component side of the board faces the front of the 5000A.

8. Turn on oscilloscope and 5000A power; allow both instruments to stabilize for at least 15 minutes.

9. Calibrate the oscilloscope for accurate (±5 mV) readings at zero and at +10 V input levels.

10. Connect the oscilloscope probe to J4-7 (Figure 5-3); connect the probe ground/shield wire to the chassis of the 5000A.

11. Select a standard resistance value for A8R4 which produces a ramp of +10 V ±40 mV to 0 V ±40 mV p-p.

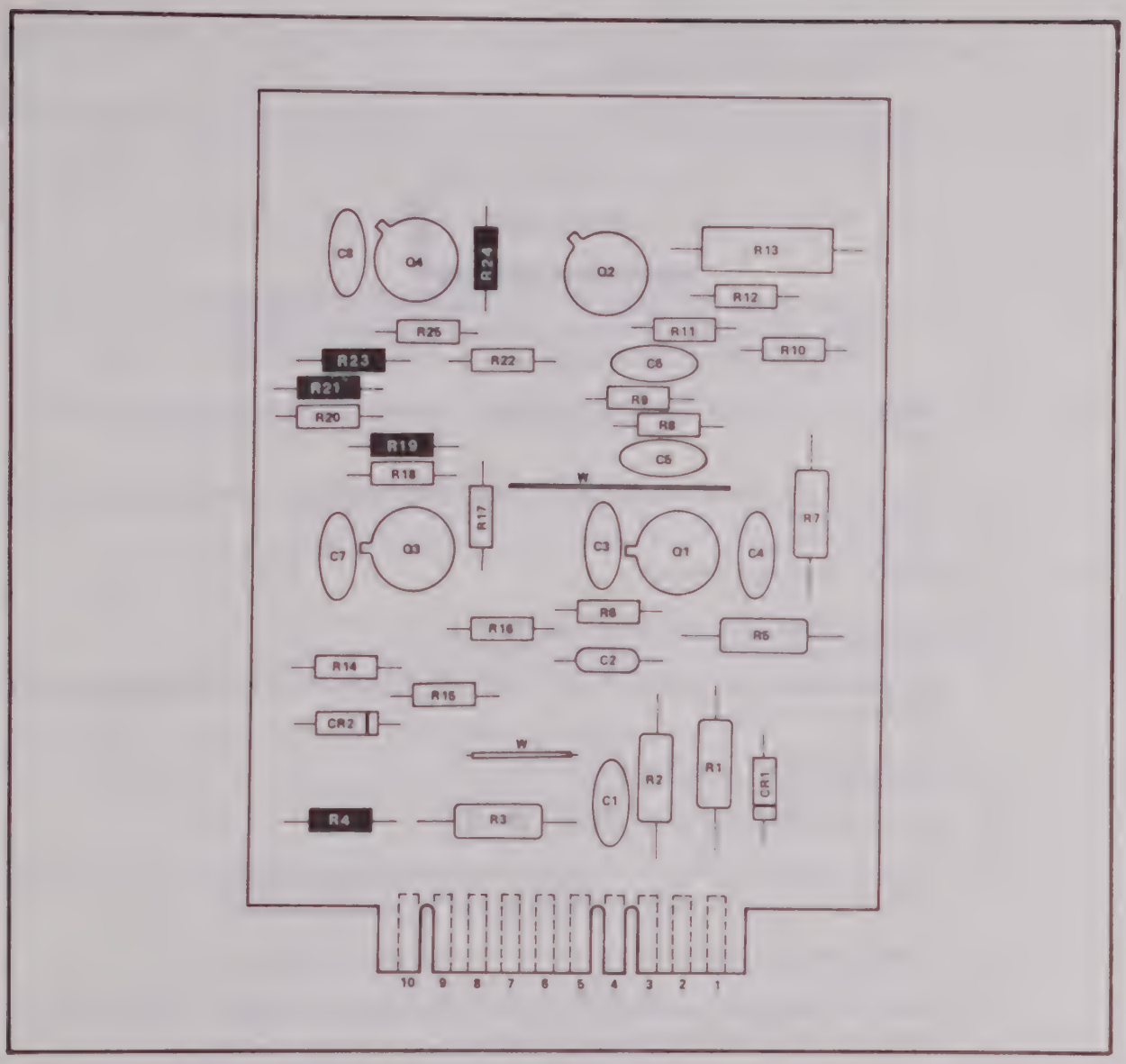


Figure 5-8. A8 Board Calibration Component Location

12. Pick the standard resistance value closest to the decade box resistance setting for A8R4. The resistor must have the following characteristics:

    a. Metal film construction

    b. Tolerance of ±2%

    c. Wattage rating of ¼ W

    d. Temperature coefficient of ±9 PPM or less

13. Permanently solder the selected resistor in place.

5-3.7.3 ΔF OFFSET AND GAIN.

1. Set the **MODE** switch to **Fc ± ΔF x 1**.
2. Rotate the **Fc ± ΔF VERNIER** control fully cw to the **CALIB** position.
3. Set the **SWEEP SECONDS** switch to **.01 SECONDS** and the **VERNIER/MANUAL SCAN** control to **X1**.
4. Set the **VERNIER** control to **0**, fully ccw.
5. Set the **RECUR-TRIG-LINE** switch to **RECUR**.
6. Remove resistor A8R19 (refer to Figure 5-8) and connect a resistance decade box in its place. Set the resistance value to match that of the resistor removed.
7. Remove resistor A8R21 (refer to Figure 5-8) and connect a resistance decade box in its place. Set the resistance value to match that of the resistor removed.
8. Place the decade boxes for A8R19 and A8R21 together.
9. Remove resistor A8R23 (refer to Figure 5-8) and connect a resistance decade box in its place. Set the resistance value to match that of the resistor removed.
10. Remove resistor A8R24 (refer to Figure 5-8) and connect a resistance decade box in its place. Set the resistance value to match that of the resistor removed.
11. Place the decade boxes for A8R23 and A8R24 together, separated from the A8R19/A8R21 boxes.
12. Calibrate the oscilloscope for accurate (±5 mV) readings at +5 V and at −5 V input levels.
13. Connect the oscilloscope probe to J4-10 (Figure 5-3); connect the probe ground/shield wire to the chassis of the 5000A.
14. Insert Extender Assembly A11 in J4.
15. Insert printed circuit assembly A8 in the mating connector of A11 so the component side of the board faces the front of the 5000A.
16. Turn on oscilloscope and 5000A power; allow both instruments to stabilize for at least 15 minutes.
17. Select standard values for A8R19/A8R21 (gain) and for A8R23/A8R24 (offset) which produce a ramp of +5 V ±20 mV to −5 V ±20 mV.
18. Pick the standard resistance values closest to the decade box resistance settings for A8R19, A8R21, A8R23, and A8R24. The resistors must have the following characteristics:
    a. Metal film construction
    b. Tolerance of ±2%

c. Wattage rating of ¼ W

d. Temperature coefficient of ±9 PPM or less

19. Permanently solder the selected resistors in place.

5-3.8 Dial Calibration

Dial calibration is accomplished with the 9210 calibration dial or any standard dial scale; three markings on the dial are significant: the first (lowest frequency) mark, the last (highest frequency) mark, and the mark in the exact center of the calibrated band. The distance between the first mark and the center mark or between the center and last marks is exactly three inches (7,62 cm).

It is not necessary to perform the procedures in a fixed order; any single control may be calibrated by itself.

5-3.8.1 INITIAL STEPS.

1. Replace the bottom cover of the 5000A if it has been removed.
2. Install any printed circuit board assemblies which have been removed.
3. Connect a cable from the 5000A FREQ VOLT connector to the digital voltmeter. Set the voltmeter to its 10 V range.
4. Connect a cable from the 5000A MARKER OUTPUT connector to the Y-axis input of the oscilloscope.
5. Install the 9210 calibration dial.
6. Turn on the 5000A, digital voltmeter, and oscilloscope. Allow all equipment to warm up for at least 15 minutes.

5-3.8.2 F1—START CONTROL.

1. Set the MODE switch to WIDE F1—F2.
2. Set the RECUR-TRIG-LINE switch to TRIG.
3. Adjust the F1—START control so the digital voltmeter reads –100 mVdc.
4. Loosen two .050 inch Allen-head set screws on the F1—START pulley shaft coupling at the end closest to R25 (see Figure 5-3).
5. Readjust the F1—START control so the center line of the gold indicator is aligned exactly with the first frequency reference mark on the dial. View the indicator straight on to eliminate parallax.
6. Re-check the digital voltmeter to verify the frequency reference output voltage is still –100 mV. If the output voltage has changed, carefully rotate the shaft of R25 with long-nose pliers to correct it.
7. Re-check the gold frequency indicator to verify it is still centered on the first dial frequency marking.

8. Repeat Steps *5* through *7* to ensure that the gold indicator is aligned with the first frequency mark at a voltage of –100 ±50 mVdc.

9. Tighten the two Allen-head screws on the R25 coupling shaft.

10. Adjust the **F1–START** control so the center line of the gold frequency indicator is aligned exactly with the center dial mark. Verify the digital voltmeter reads –5.0 V ±50 mVdc. If the reading is not within specification, note the direction and amplitude of the error, but do not make any changes at this time.

11. Adjust the **F1–START** control so the center line of the gold frequency indicator is aligned exactly with the last frequency mark.

12. Verify the voltmeter reading is –9.9 V ±50 mVdc. If this reading and the reading in Step *10* are within the specified tolerance, proceed to the next control requiring calibration. If the reading is out of specification, go on to Step *13*.

13. Loosen two .050-inch Allen-head set screws on the **F1–START** pulley shaft.

14. Adjust the **F1–START** control so the voltmeter reading is within the specified tolerance of ±50 mVdc at –100 mVdc (left-hand dial mark), –5.0 Vdc (center dial mark), and –9.9 Vdc (right-hand dial mark).

5-3.8.3 F2–STOP CONTROL.

1. Set the **MODE** switch to **WIDE F1–F2**.

2. Set the **RECUR-TRIG-LINE** switch to **TRIG**.

3. Set the **SWEEP SECONDS** switch to **MANUAL SCAN** and rotate the **VERNIER/ MANUAL SCAN** control fully cw.

4. Adjust the **F2–STOP** control so the digital voltmeter reads –100 mVdc.

5. Loosen two .050-inch Allen-head set screws on the **F2–STOP** pulley shaft coupling at the end closest to R12 (see Figure 5-3).

6. Readjust the **F2–STOP** control so the center line of the orange indicator is aligned exactly with the first frequency reference mark on the dial.

7. Re-check the digital voltmeter to verify the frequency reference output voltage is still –100 mV. If the output voltage has changed, carefully rotate the shaft of R12 with long-nose pliers to correct it.

8. Re-check the orange frequency indicator to verify it is still centered on the first dial frequency marking.

9. Repeat Steps *6* through *8* to ensure that the gold indicator is aligned with the first frequency mark at a voltage of –100 ±50 mVdc.

10. Tighten the two Allen-head screws on the R12 coupling shaft.

11. Adjust the F2–STOP control so the center line of the orange frequency indicator is aligned exactly with the center dial mark. Verify the digital voltmeter reads –5.0 V ±50 mVdc. If the reading is not within specification, note the direction and amplitude of error, but do not make any changes at this time.

12. Adjust the F2–STOP control so the center line of the orange frequency indicator is aligned exactly with the last frequency mark.

13. Verify the voltmeter reading is –9.9 V ±50 mVdc. If this reading and the reading in Step *11* are within the specified tolerance, proceed to the next control requiring calibration. If the reading is out of specification, go on to Step *14*.

14. Loosen two .050-inch Allen-head set screws on the F2–STOP pulley shaft.

15. Adjust the F2–STOP control so the voltmeter reading is within the specified tolerance of ±50 mVdc at –100 mVdc (left-hand dial mark), –5.0 Vdc (center dial mark), and –9.9 Vdc (right-hand dial mark).

5-3.8.4 MARKER 2–Fc CONTROL.

1. Set the MODE switch to CW.

2. Set the RECUR-TRIG-LINE switch to TRIG.

3. Adjust the MARKER 2–Fc control so the digital voltmeter reads –100 mVdc.

4. Loosen two .050-inch Allen-head set screws on the MARKER 2–Fc pulley shaft coupling at the end closest to R26 (see Figure 5-3).

5. Readjust the F1–START control so the center line of the red indicator is aligned exactly with the first frequency reference mark on the dial. View the indicator straight on to eliminate parallax.

6. Re-check the digital voltmeter to verify the frequency reference output voltage is still –100 mV. If the output voltage has changed, carefully rotate the shaft of R26 with long-nose pliers to correct it.

7. Re-check the red frequency indicator to verify it is still centered on the first dial frequency marking.

8. Repeat Steps *5* through *7* to ensure that the red indicator is aligned with the first frequency mark at a voltage of –100 ±50 mVdc.

9. Tighten the two Allen-head screws on the R26 coupling shaft.

10. Adjust the MARKER 2–Fc control so the center line of the red frequency indicator is aligned exactly with the center dial mark. Verify the digital voltmeter reads –5.0 V ±50 mVdc. If the reading is not within specification, note the direction and amplitude of the error, but do not make any changes at this time.

11. Adjust the MARKER 2–Fc control so the center line of the red frequency indicator is aligned exactly with the last frequency mark.

12. Verify the voltmeter reading is –9.9 V ±50 mVdc. If this reading and the reading in Step *10* are within the specified tolerance, proceed to the next control requiring calibration. If the reading is out of specification, go on to Step *13*.

13. Loosen two .050-inch Allen-head set screws on the **MARKER 2–Fc** pulley shaft.

14. Adjust the **MARKER 2–Fc** control so the voltmeter reading is within the specified tolerance of ±50 mVdc at –100 mVdc (left-hand dial mark), –5.0 Vdc (center dial mark) and –9.9 Vdc (right-hand dial mark).

5-3.8.5 MARKER 1 CONTROL.

1. Set the **MODE** switch to **WIDE F1–F2**.

2. Adjust the **VERNIER/MANUAL SCAN** control for a voltmeter reading of –5.0 V ±50 mVdc.

3. Set the **F1–START** control to maximum ccw rotation and the **F2–STOP** control to maximum cw rotation.

4. Set the **MARKER 2–Fc** and **MARKER 3** controls to maximum cw rotation.

5. Adjust the **MARKER 1** control for the maximum negative deflection (nominally –1 V) of the trace on the dc-coupled oscilloscope.

6. Loosen two .050-inch Allen-head set screws on the **MARKER 1** pulley shaft coupling at the end closest to R14 (refer to Figure 5-3).

7. Readjust the **MARKER 1** control so the center line of the green indicator is aligned exactly with the center dial marking.

8. Re-check the voltmeter to ensure the voltage is –5.0 V ±50 mVdc at the center frequency marking. Re-check the oscilloscope to ensure the voltage is still at maximum deflection, then tighten the set screws.

5-3.8.6 MARKER 3 CONTROL.

1. Set the **MODE** switch to **WIDE F1–F2**.

2. Adjust the **VERNIER/MANUAL SCAN** control for a voltmeter reading of –5.0 V ±50 mVdc.

3. Set the **F1–START** control to maximum ccw rotation and the **F2–STOP** control to maximum cw rotation.

4. Set the **MARKER 1** and **MARKER 2–Fc** controls to maximum cw rotation.

5. Adjust the **MARKER 2–Fc** control for the maximum negative deflection (nominally –1 V) of the trace on the dc-coupled oscilloscope.

6. Loosen two .050-inch Allen-head set screws on the **MARKER 3** pulley shaft coupling at the end closest to R16 (refer to Figure 5-3).

7. Readjust the **MARKER 3** control so the center line of the green indicator is aligned exactly with the center dial marking.

8. Re-check the voltmeter to ensure the voltage is –5.0 ±50 mVdc at the center frequency marking. Re-check the oscilloscope to ensure the voltage is still at maximum deflection, then tighten the set screws.

SECTION VI

MAINTENANCE

6-1. GENERAL

This section contains instructions for routine servicing and cleaning of the 5000A, and for the isolation and repair of malfunctioning circuits and components.

6-2. ROUTINE MAINTENANCE

In normal laboratory environments, the sweeper requires only brief annual service. When operated under more severe conditions (dusty or chemically-contaminated environments), more frequency service is required.

1. Turn the power off, then unplug the power connector.
2. Remove the top cover by removing four Phillips-head screws and lifting the cover off; savethe screws. The bottom cover may be removed in the same manner.
3. Remove any accumulated dust or other foreign material with a soft brush and low-pressure dry air.
4. Vacuum-clean the area around the van and all ventilation holes.
5. Inspect the inside of the unit carefully for loose screws, nuts, etc.; tighten any hardware requiring it.
6. Check the unit carefully for damaged or overheated components, pieces of loose solder or wire, frayed wire insulation, etc.
7. Check the plug-in printed circuit assemblies to make sure they are firmly seated in their sockets.
8. Replace the top and bottom covers.

6-3. CALIBRATION

The Performance Checks of Paragraph 5-2 should be completed annually. The referenced procedures are found in Section V of this manual.

6-4. CORRECTIVE MAINTENANCE

6-4.1 Trouble Isolation (Figure 6-1)

6-4.1.1 TROUBLE ISOLATION PROCESS. The performance checks in Section V provide the principle means of determining that performance of the 5000A is within specified parameters. In the event of evident failure or malfunction, certain logical steps must be followed and decisions made to effect repair or correct a malfunction within the shortest period possible. The basic process may be summarized as follows:

1. Does a malfunction in fact exist, or is an evident malfunction the result of incorrect switch or control positioning, incorrect external input signals, or misapplication of the sweeper/plug-in system?

2. If a malfunction does exist, is the fault in the plug-in or in the mainframe?

3. If the malfunction is within the mainframe, in which circuit or circuits is it located?

4. Which components within the affected circuits have malfunctioned?

5. What caused the malfunction, and will simple replacement of faulty components solve the problem permanently?

6-4.1.2 SUPPORTING INFORMATION. Figure 6-1 is an aid to trouble isolation, to be used in conjunction with the following information:

1. The detailed circuit descriptions and block diagrams in Section IV.

2. The schematic diagrams and board component-location drawings in Section VIII.

3. The basing diagrams of electrical and semiconductor devices used in the 5000A, shown in Figure 8-1 and on each board drawing in Section VIII.

4. The subassembly and component location information in Figures 5-3 and 7-1.

6-4.1.3 TROUBLE ISOLATION DIAGRAMS. Figure 6-1 comprises six separate sequences to isolate malfunctions from the system level to the malfunctioning circuit. The figure, located at the end of this section, is organized as follows:

1. *START Sequence*. This sequence is used to direct the troubleshooter to the malfunctioning circuit area within the sweeper mainframe/plug-in system.

2. *Sequence A* is concerned with power supply input conditioning components.

3. *Sequence B* is concerned with the power supply components and regulator boards; this sequence is divided into several sub-sequences, one for each of the power supply outputs.

4. *Sequence C* is used to isolate faults in the ramp generator circuits.

5. *Sequence D* is concerned with the mode generator circuits.

6. *Sequence E* covers the marker generator.

6-4.2 Test Equipment

The test equipment listed in Table 5-2, Section V, should be used for trouble isolation.

CAUTION

BE VERY CAREFUL WITH OSCILLOSCOPE AND VOLTMETER PROBES TO AVOID ACCIDENTALLY BRIDGING TWO POINTS OR SHORT-CIRCUITING A WIRE OR COMPONENT LEAD TO GROUND. LACK OF ADEQUATE CARE WITH SEMICONDUCTOR AND INTEGRATED CIRCUITS CAN TURN RELATIVELY MINOR PROBLEMS INTO COSTLY EXPERIENCES.

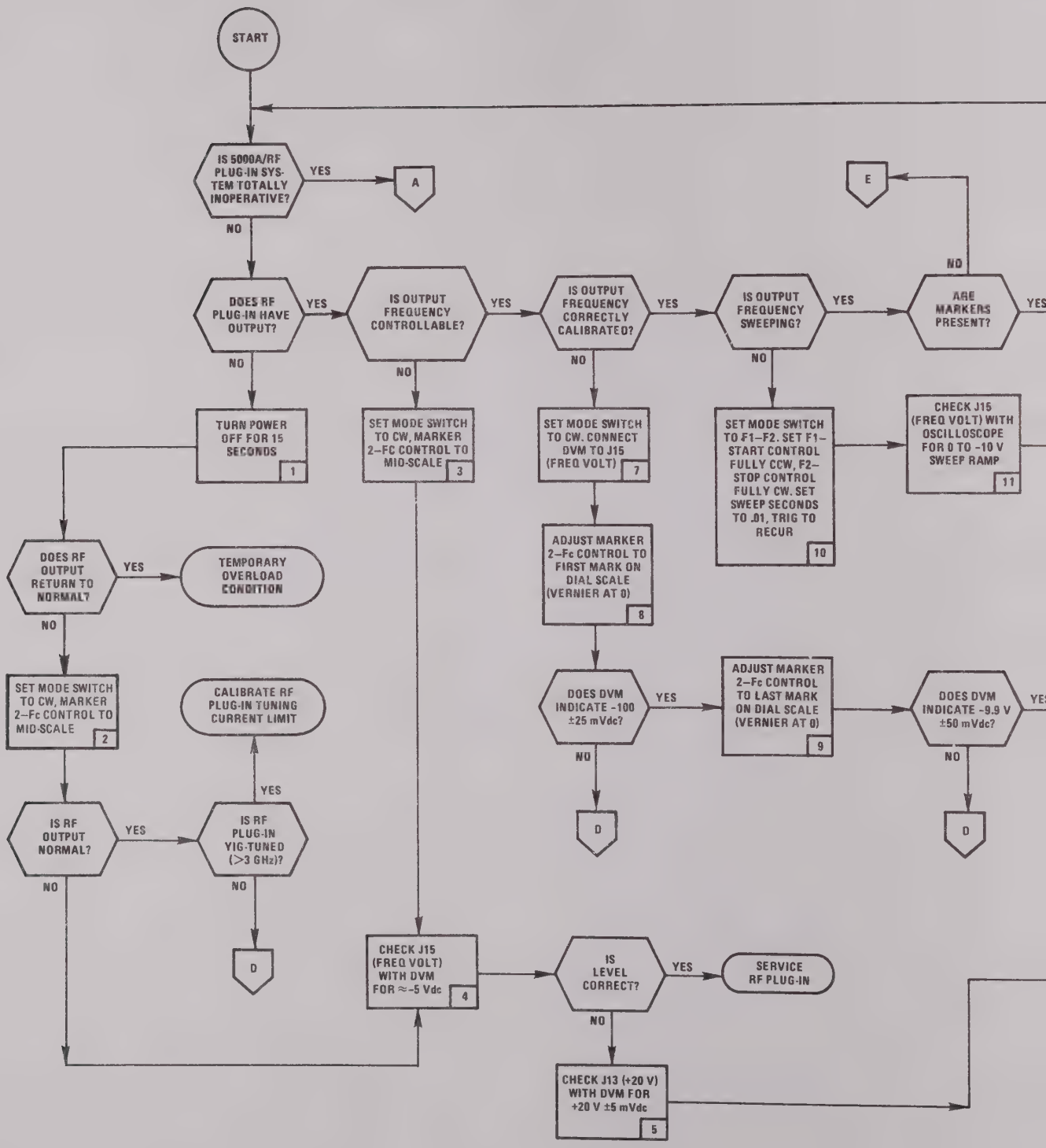
Systron-Donner Extender 950007, supplied with the 5000A as assembly A11, is required for trouble isolation of the plug-in printed circuit assemblies.

6-4.3 Printed Circuit Board Repair

Repair of the plug-in comprises location and replacement of defective components. To avoid damage to the printed circuit boards and precision components, solder or remove components only with a low-power (25 to 50 W, 500 to 650°) soldering iron. Do not use soldering guns or large irons. Use only 60-40 or 63-37 rosin core solder. To remove the integrated circuit operational amplifiers or other multi-lead devices, use a special iron tip that unsolders all leads at the same time (available from Ungar and other manufacturers). Remove excess solder from circuit board holes with a vacuum de-soldering device (available from Edsyn, Ungar, Wen, Viking, etc.)

6-4.4 Component Removal and Re-assembly

Use the *Illustrated Parts Breakdown* — Figure 7-1 of Section VII — as a guide to disassembly and reassembly sequences.


START
IS 5000A/RF PLUG-IN SYSTEM TOTALLY INOPERATIVE?
YES
A
NO
DOES RF PLUG-IN HAVE OUTPUT?
YES
IS OUTPUT FREQUENCY CONTROLLABLE?
YES
IS OUTPUT FREQUENCY CORRECTLY CALIBRATED?
YES
IS OUTPUT FREQUENCY SWEEPING?
YES
ARE MARKERS PRESENT?
YES
E
NO
NO
NO
NO
NO
TURN POWER OFF FOR 15 SECONDS 1
SET MODE SWITCH TO CW, MARKER 2–FC CONTROL TO MID-SCALE 3
SET MODE SWITCH TO CW. CONNECT DVM TO J15 (FREQ VOLT) 7
SET MODE SWITCH TO F1–F2. SET F1–START CONTROL FULLY CCW, F2–STOP CONTROL FULLY CW. SET SWEEP SECONDS TO .01, TRIG TO RECUR 10
CHECK J15 (FREQ VOLT) WITH OSCILLOSCOPE FOR 0 TO –10 V SWEEP RAMP 11
DOES RF OUTPUT RETURN TO NORMAL?
YES
TEMPORARY OVERLOAD CONDITION
NO
ADJUST MARKER 2–Fc CONTROL TO FIRST MARK ON DIAL SCALE (VERNIER AT 0) 8
SET MODE SWITCH TO CW, MARKER 2–Fc CONTROL TO MID-SCALE 2
CALIBRATE RF PLUG-IN TUNING CURRENT LIMIT
DOES DVM INDICATE –100 ±25 mVdc?
YES
ADJUST MARKER 2–Fc CONTROL TO LAST MARK ON DIAL SCALE (VERNIER AT 0) 9
DOES DVM INDICATE –9.9 V ±50 mVdc?
YES
NO
NO
D
D
IS RF OUTPUT NORMAL?
YES
IS RF PLUG-IN YIG-TUNED (>3 GHz)?
YES
NO
NO
D
CHECK J15 (FREQ VOLT) WITH DVM FOR ≈–5 Vdc 4
IS LEVEL CORRECT?
YES
SERVICE RF PLUG-IN
NO
CHECK J13 (+20 V) WITH DVM FOR +20 V ±5 mVdc 5

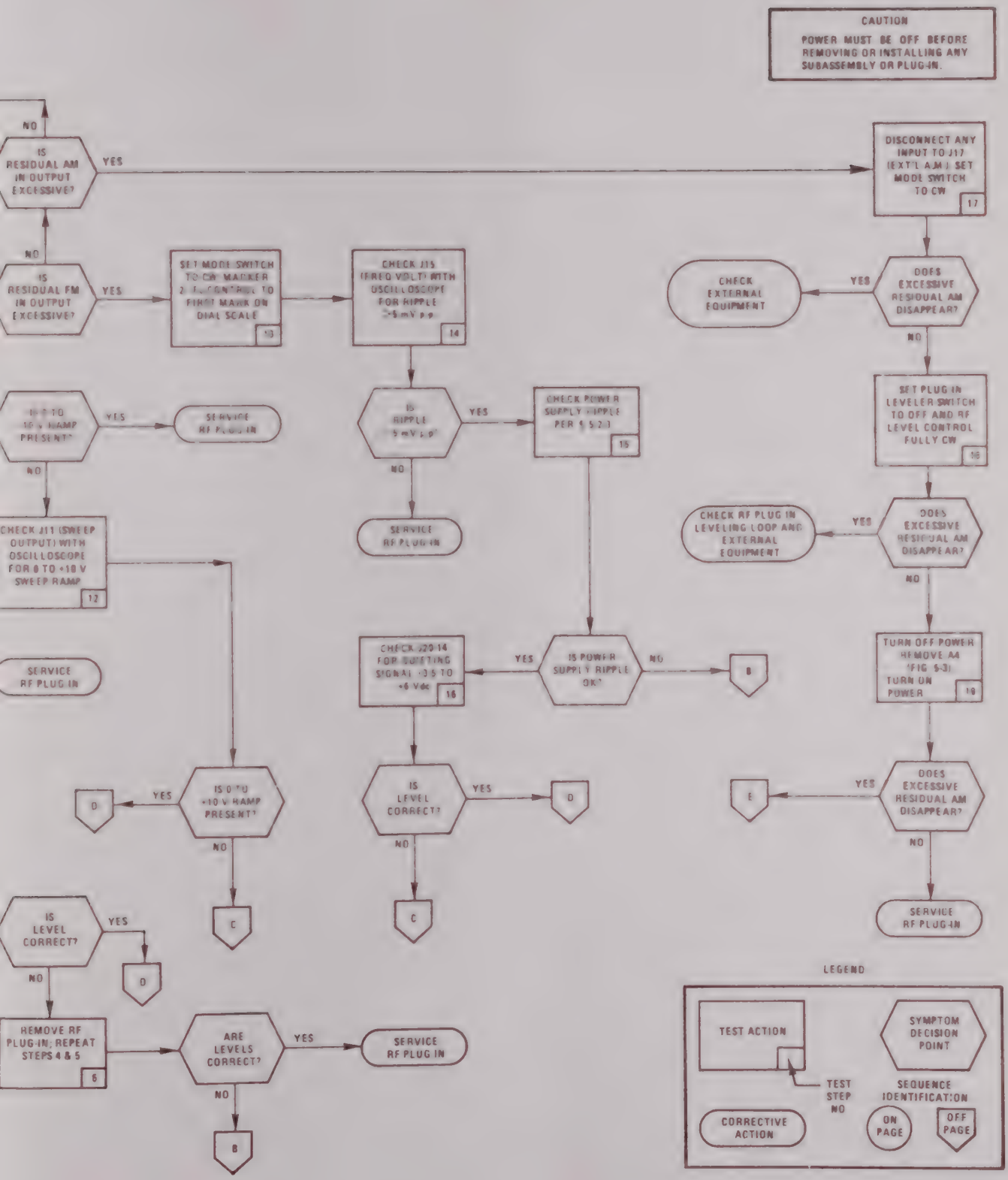
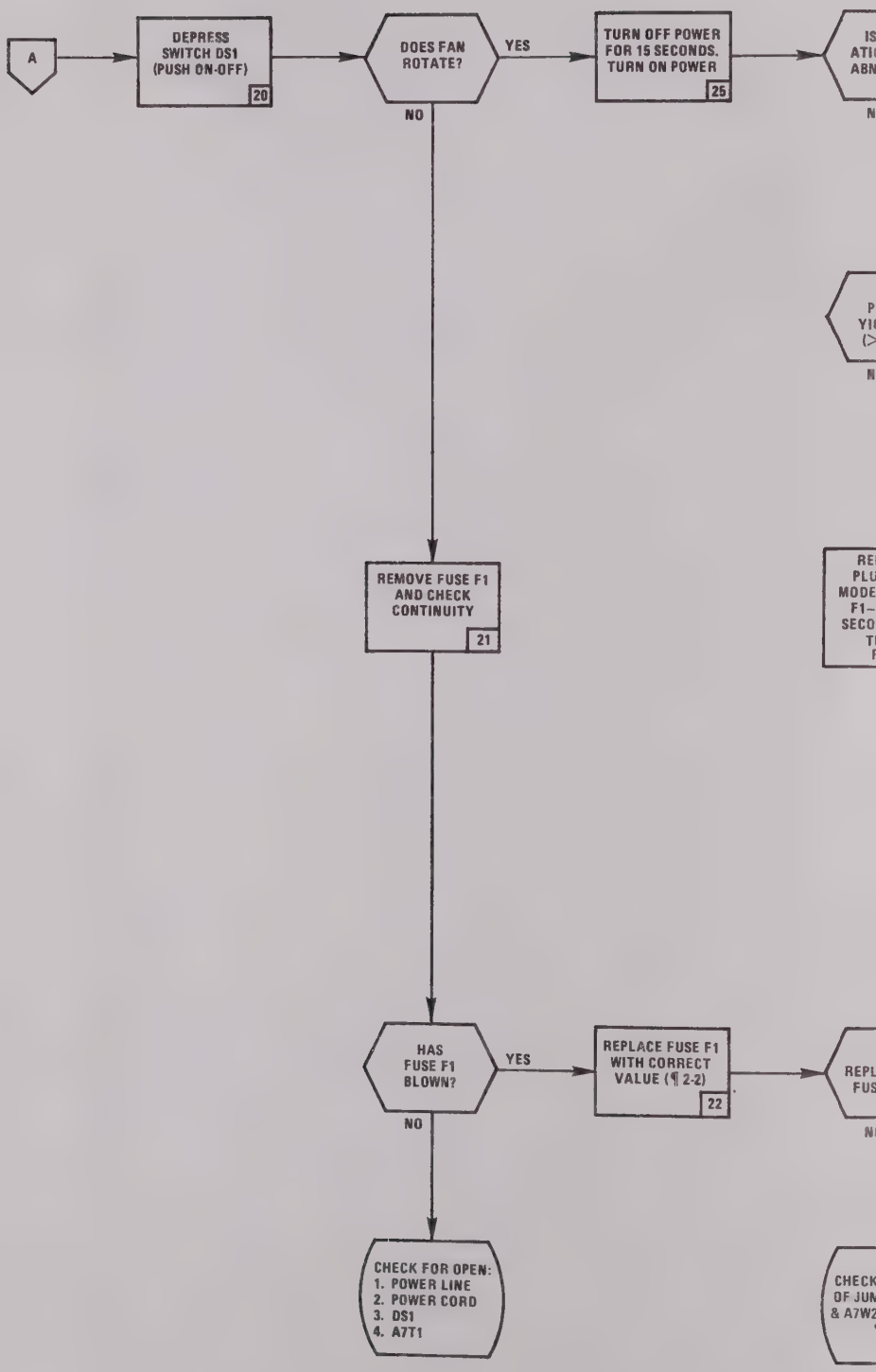

CAUTION
POWER MUST BE OFF BEFORE REMOVING OR INSTALLING ANY SUBASSEMBLY OR PLUG-IN.
IS RESIDUAL AM IN OUTPUT EXCESSIVE?
YES
NO
DISCONNECT ANY INPUT TO J17 (EXT'L A.M.) SET MODE SWITCH TO CW
17
IS RESIDUAL FM IN OUTPUT EXCESSIVE?
SET MODE SWITCH TO CW MARKER
CHECK J15 (FREQ VOLT) WITH OSCILLOSCOPE FOR RIPPLE
14
CHECK EXTERNAL EQUIPMENT
DOES EXCESSIVE RESIDUAL AM DISAPPEAR?
SET PLUG-IN LEVELER SWITCH TO OFF AND RF LEVEL CONTROL FULLY CW
16
SERVICE RF PLUG-IN
IS RIPPLE
CHECK POWER SUPPLY RIPPLE
15
CHECK J11 (SWEEP OUTPUT) WITH OSCILLOSCOPE FOR 0 TO +10 V SWEEP RAMP
12
CHECK RF PLUG-IN LEVELING LOOP AND EXTERNAL EQUIPMENT
CHECK J20-14 FOR SWEEPING SIGNAL -0.5 TO +6 Vdc
18
IS POWER SUPPLY RIPPLE OK?
TURN OFF POWER REMOVE A4 (FIG. 5-3) TURN ON POWER
19
IS LEVEL CORRECT?
REMOVE RF PLUG-IN; REPEAT STEPS 4 & 5
6
ARE LEVELS CORRECT?
LEGEND
TEST ACTION
SYMPTOM DECISION POINT
TEST STEP NO
SEQUENCE IDENTIFICATION
CORRECTIVE ACTION
ON PAGE
OFF PAGE

Figure 6-1. Troubleshooting Diagram (Sheet 1)


A
DEPRESS SWITCH DS1 (PUSH ON-OFF)
20
DOES FAN ROTATE?
YES
NO
TURN OFF POWER FOR 15 SECONDS. TURN ON POWER
25
REMOVE FUSE F1 AND CHECK CONTINUITY
21
HAS FUSE F1 BLOWN?
YES
NO
REPLACE FUSE F1 WITH CORRECT VALUE (¶ 2-2)
22
CHECK FOR OPEN:
1. POWER LINE
2. POWER CORD
3. DS1
4. A7T1

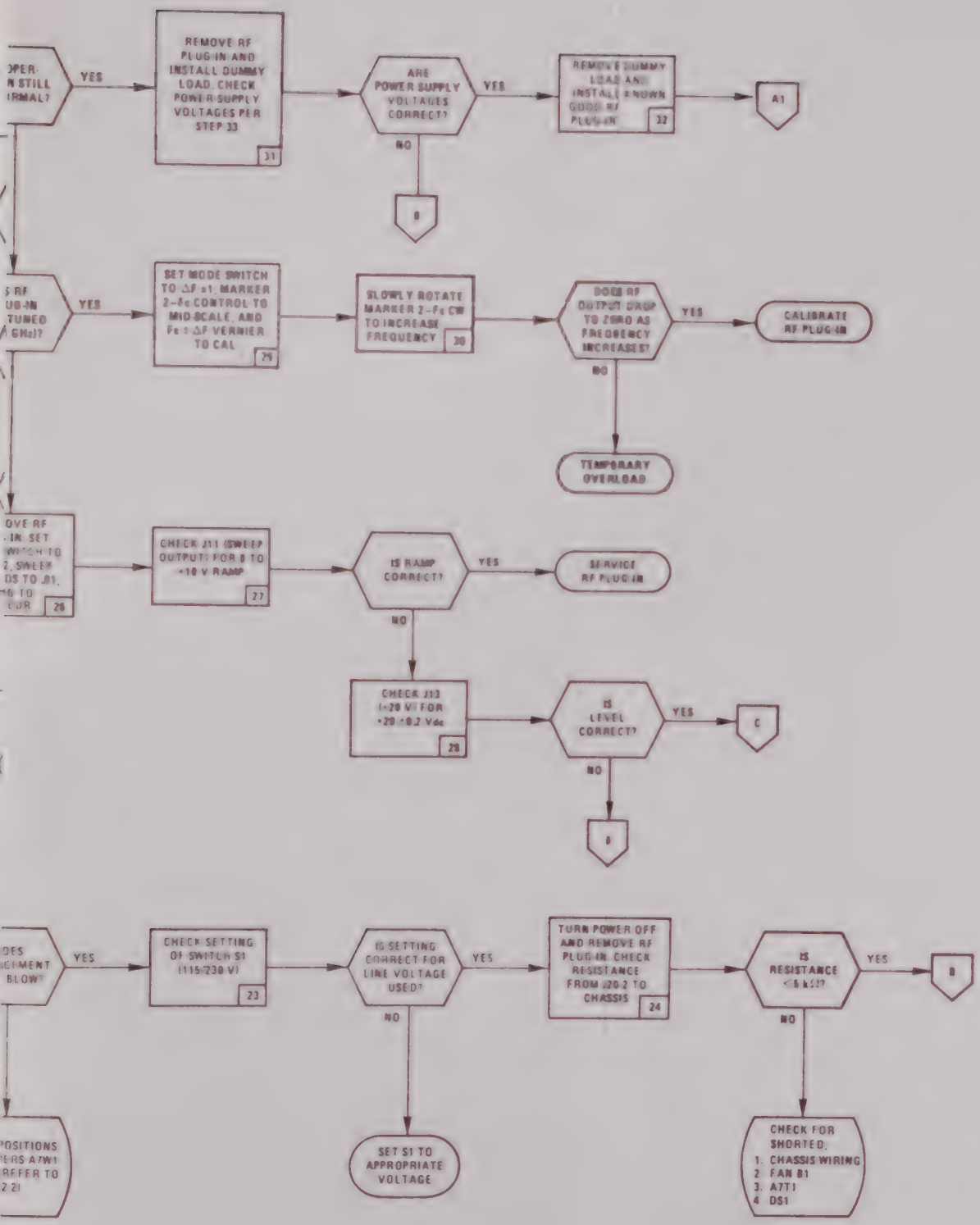
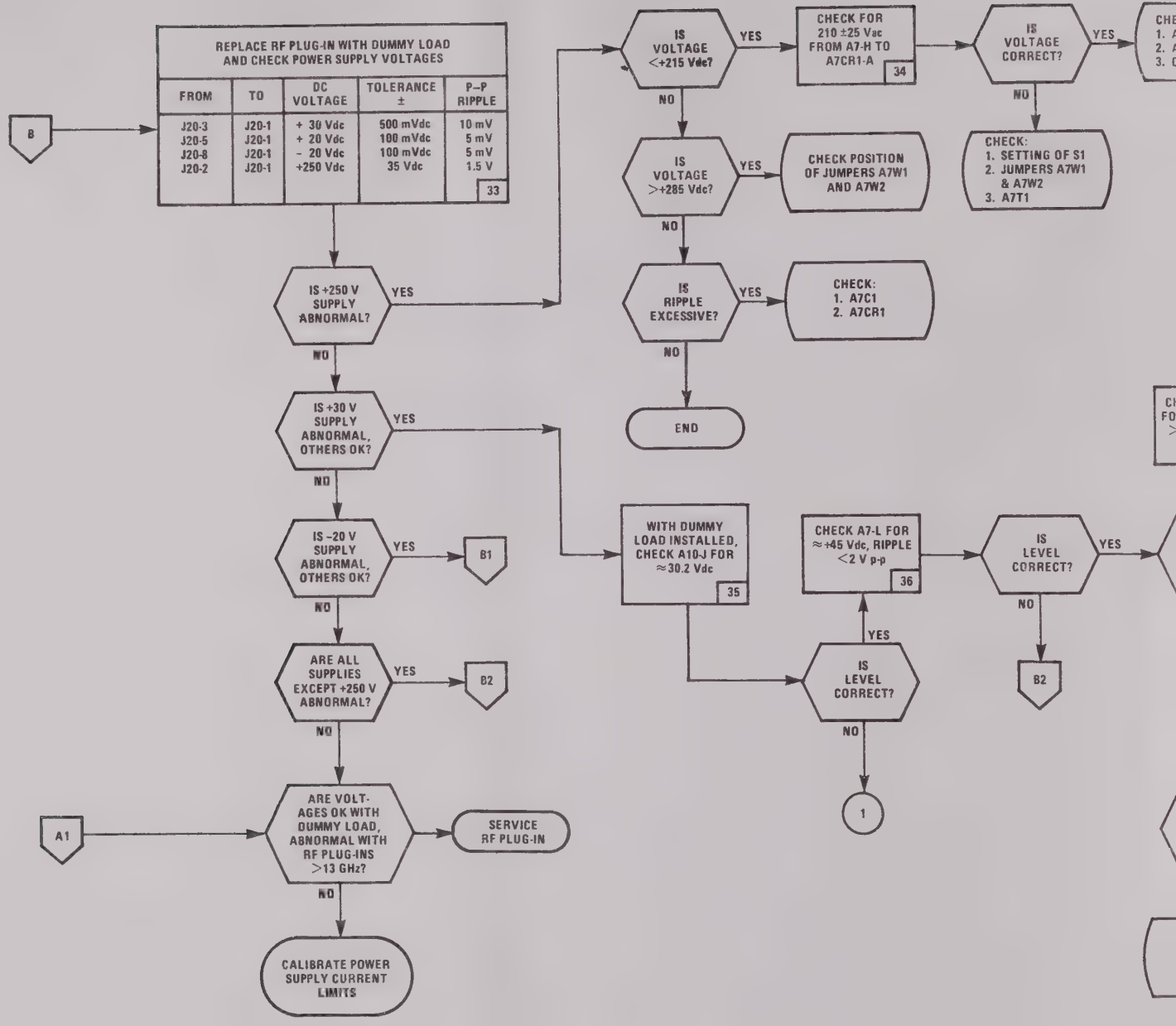


Figure 6-1. Troubleshooting Diagram (Sheet 2)


B
REPLACE RF PLUG-IN WITH DUMMY LOAD AND CHECK POWER SUPPLY VOLTAGES
FROM
TO
DC VOLTAGE
TOLERANCE ±
P–P RIPPLE
J20-3
J20-5
J20-8
J20-2
J20-1
J20-1
J20-1
J20-1
+ 30 Vdc
+ 20 Vdc
– 20 Vdc
+250 Vdc
500 mVdc
100 mVdc
100 mVdc
35 Vdc
10 mV
5 mV
5 mV
1.5 V
33
IS +250 V SUPPLY ABNORMAL?
YES
NO
IS +30 V SUPPLY ABNORMAL, OTHERS OK?
YES
NO
IS –20 V SUPPLY ABNORMAL, OTHERS OK?
YES
B1
NO
ARE ALL SUPPLIES EXCEPT +250 V ABNORMAL?
YES
B2
NO
A1
ARE VOLTAGES OK WITH DUMMY LOAD, ABNORMAL WITH RF PLUG-INS >13 GHz?
SERVICE RF PLUG-IN
NO
CALIBRATE POWER SUPPLY CURRENT LIMITS
IS VOLTAGE <+215 Vdc?
YES
CHECK FOR 210 ±25 Vac FROM A7-H TO A7CR1-A
34
IS VOLTAGE CORRECT?
YES
NO
CHECK:
1. SETTING OF S1
2. JUMPERS A7W1 & A7W2
3. A7T1
NO
IS VOLTAGE >+285 Vdc?
YES
CHECK POSITION OF JUMPERS A7W1 AND A7W2
NO
IS RIPPLE EXCESSIVE?
YES
CHECK:
1. A7C1
2. A7CR1
NO
END
WITH DUMMY LOAD INSTALLED, CHECK A10-J FOR ≈30.2 Vdc
35
CHECK A7-L FOR ≈+45 Vdc, RIPPLE <2 V p-p
36
IS LEVEL CORRECT?
YES
NO
B2
YES
IS LEVEL CORRECT?
NO
1

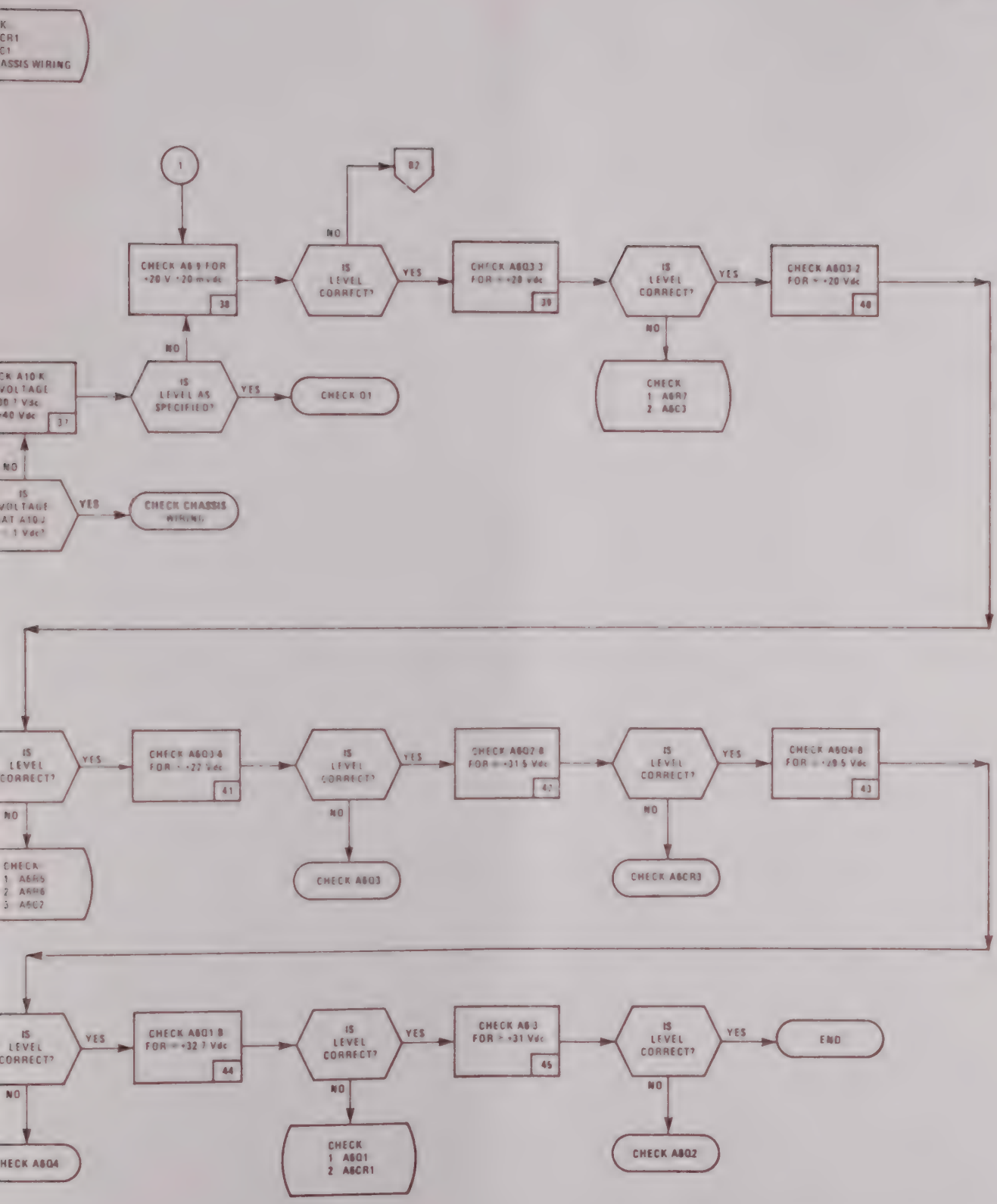
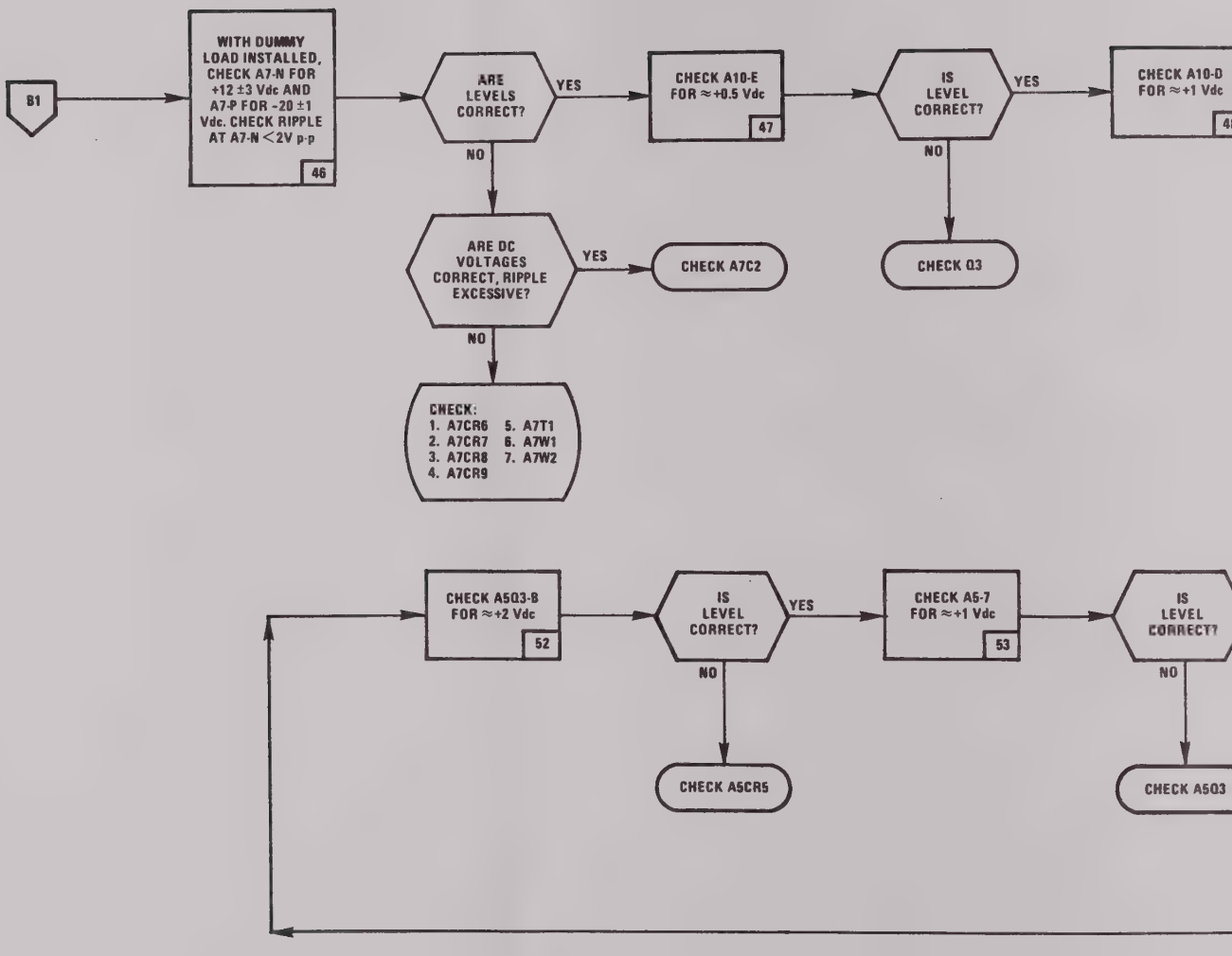


Figure 6-1. Troubleshooting Diagram (Sheet 3)


B1
WITH DUMMY LOAD INSTALLED, CHECK A7-N FOR +12 ±3 Vdc AND A7-P FOR -20 ±1 Vdc. CHECK RIPPLE AT A7-N <2V p-p
46
ARE LEVELS CORRECT?
YES
NO
CHECK A10-E FOR ≈+0.5 Vdc
47
IS LEVEL CORRECT?
YES
NO
CHECK A10-D FOR ≈+1 Vdc
ARE DC VOLTAGES CORRECT, RIPPLE EXCESSIVE?
YES
NO
CHECK A7C2
CHECK Q3
CHECK:
1. A7CR6
2. A7CR7
3. A7CR8
4. A7CR9
5. A7T1
6. A7W1
7. A7W2
CHECK A5Q3-B FOR ≈+2 Vdc
52
IS LEVEL CORRECT?
YES
NO
CHECK A5-7 FOR ≈+1 Vdc
53
IS LEVEL CORRECT?
NO
CHECK A5CR5
CHECK A5Q3

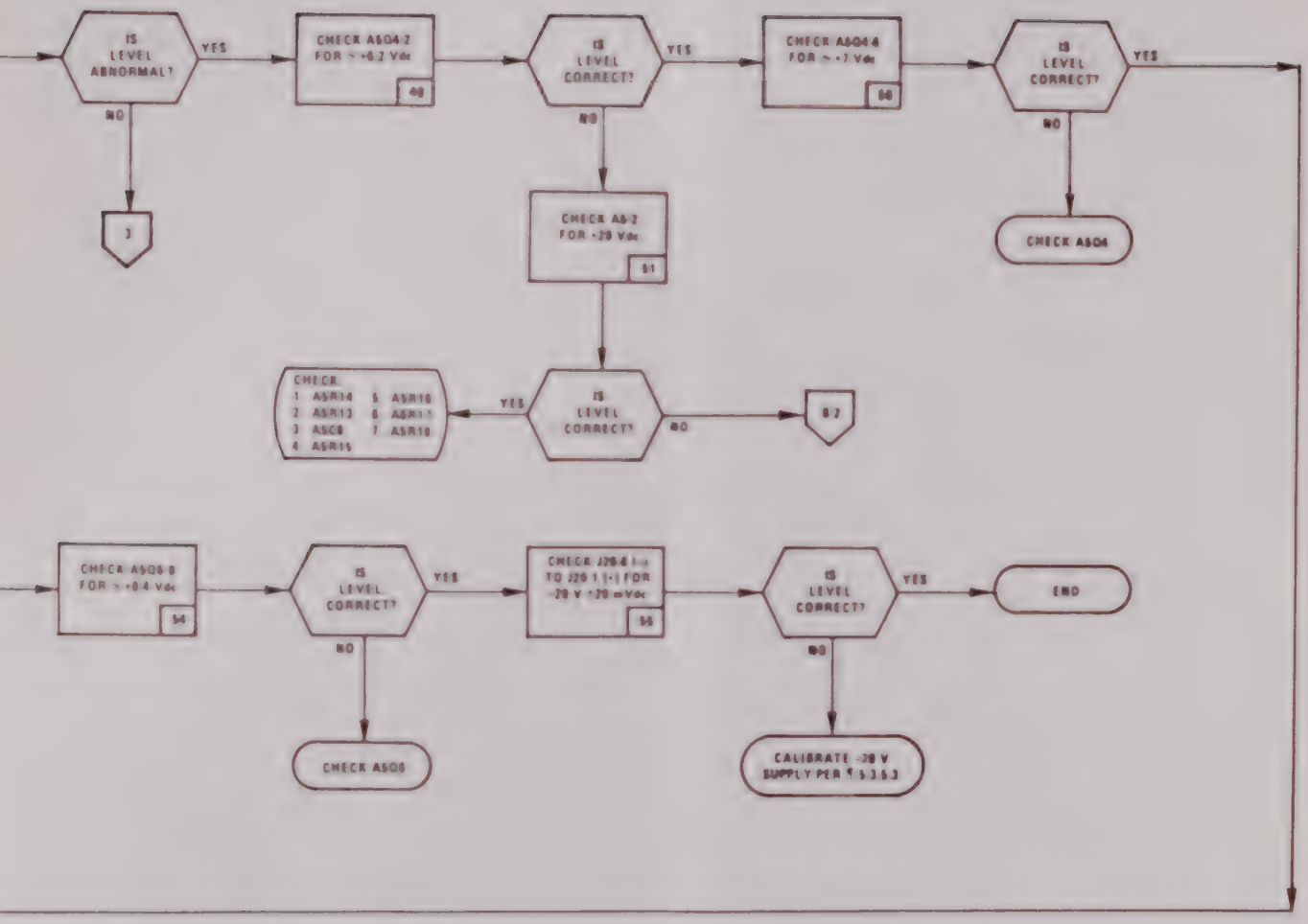
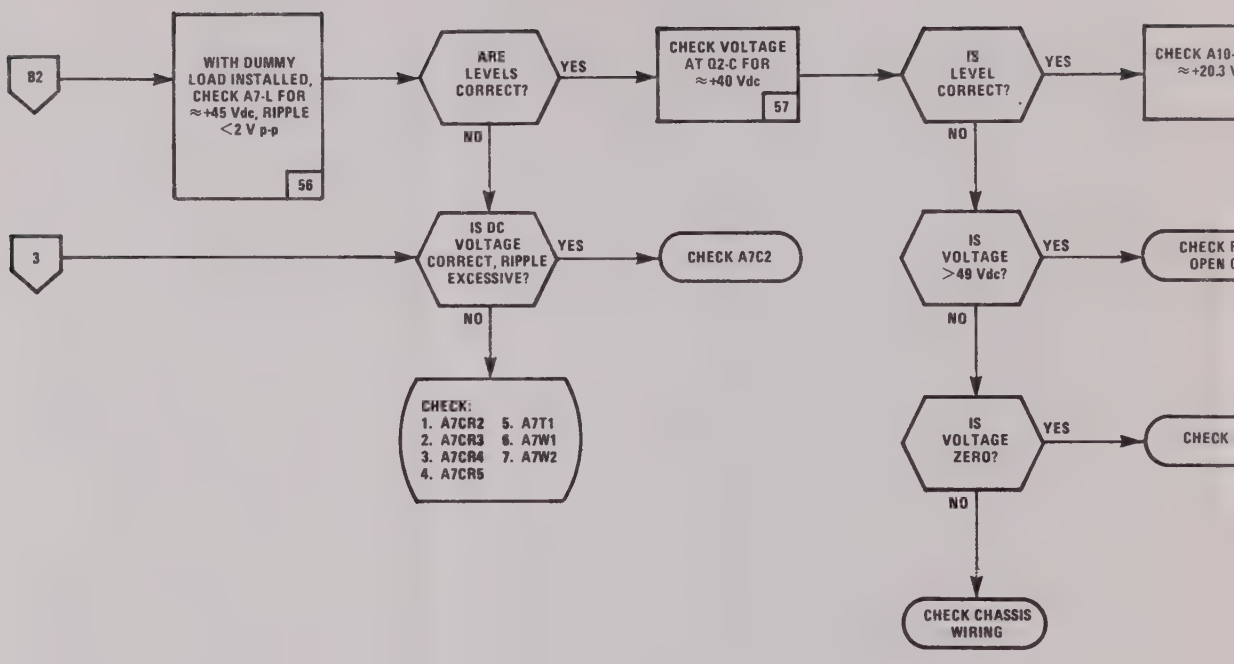
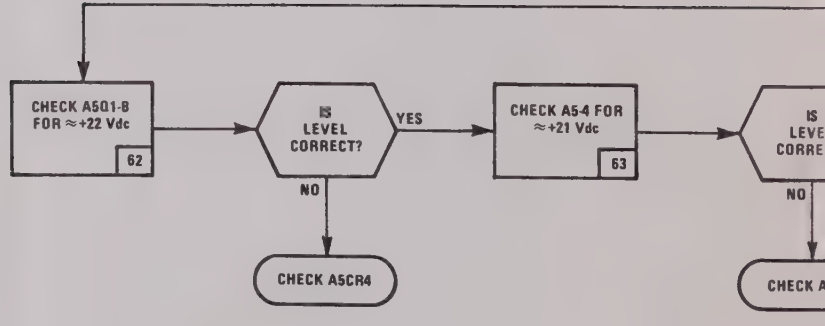


Figure 6-1. Troubleshooting Diagram (Sheet 4)


B2
WITH DUMMY LOAD INSTALLED, CHECK A7-L FOR ≈+45 Vdc, RIPPLE <2 V p-p
56
ARE LEVELS CORRECT?
YES
NO
CHECK VOLTAGE AT Q2-C FOR ≈+40 Vdc
57
IS LEVEL CORRECT?
YES
NO
CHECK A10
≈+20.3
3
IS DC VOLTAGE CORRECT, RIPPLE EXCESSIVE?
YES
NO
CHECK A7C2
CHECK:
1. A7CR2
2. A7CR3
3. A7CR4
4. A7CR5
5. A7T1
6. A7W1
7. A7W2
IS VOLTAGE >49 Vdc?
YES
NO
CHECK
OPEN
IS VOLTAGE ZERO?
YES
NO
CHECK
CHECK CHASSIS WIRING


CHECK A5Q1-B FOR ≈+22 Vdc
62
IS LEVEL CORRECT?
YES
NO
CHECK A5CR4
CHECK A5-4 FOR ≈+21 Vdc
63
IS
LEVE
CORRE
NO
CHECK A

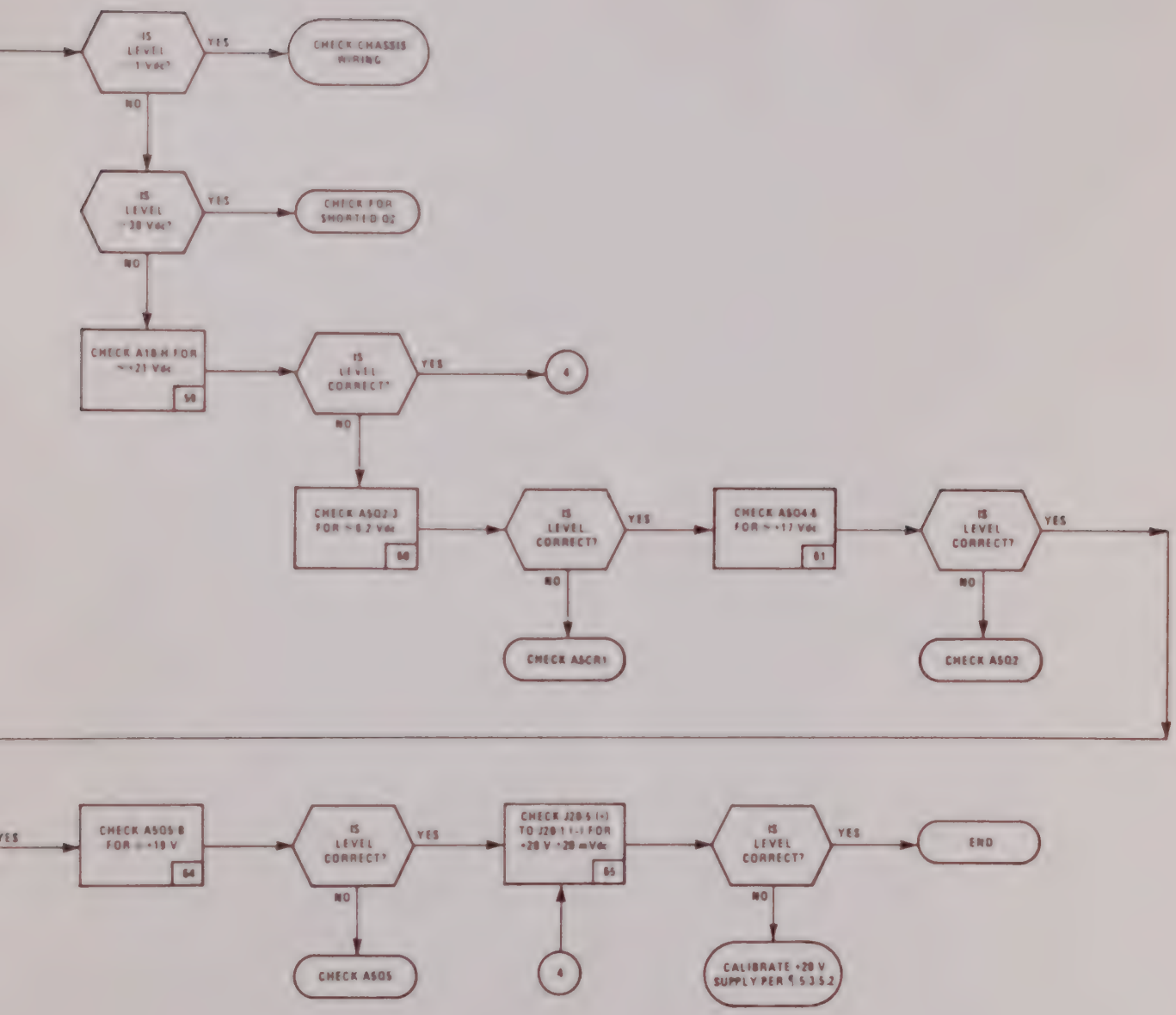
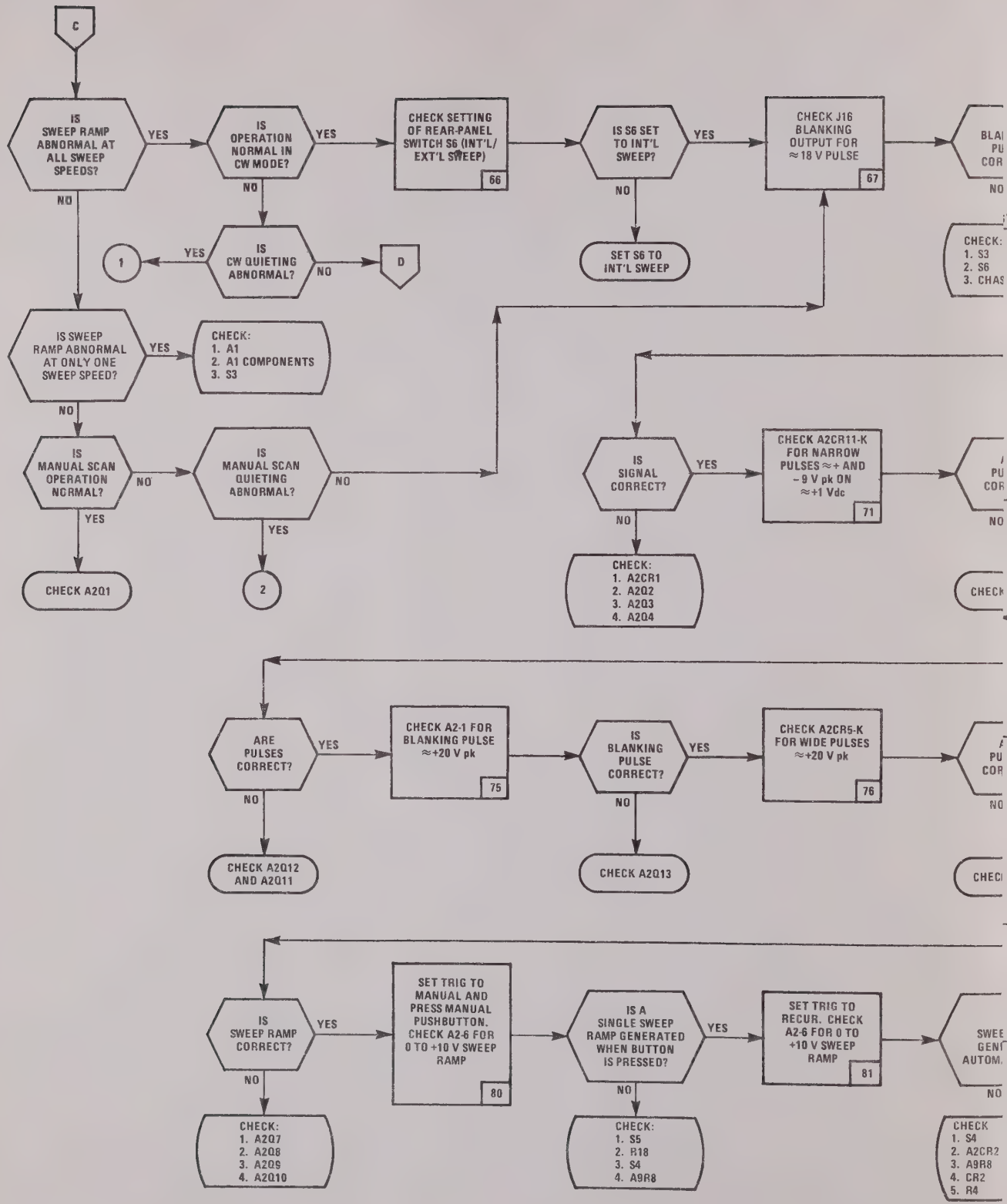


Figure 6-1. Troubleshooting Diagram (Sheet 5)


C
IS SWEEP RAMP ABNORMAL AT ALL SWEEP SPEEDS?
YES
NO
IS OPERATION NORMAL IN CW MODE?
YES
NO
CHECK SETTING OF REAR-PANEL SWITCH S6 (INT'L/ EXT'L SWEEP)
66
IS S6 SET TO INT'L SWEEP?
YES
NO
SET S6 TO INT'L SWEEP
CHECK J16 BLANKING OUTPUT FOR ≈18 V PULSE
67
NO
CHECK:
1. S3
2. S6
3. CHAS
1
IS CW QUIETING ABNORMAL?
YES
NO
D
IS SWEEP RAMP ABNORMAL AT ONLY ONE SWEEP SPEED?
YES
CHECK:
1. A1
2. A1 COMPONENTS
3. S3
NO
IS MANUAL SCAN OPERATION NORMAL?
NO
YES
CHECK A2Q1
IS MANUAL SCAN QUIETING ABNORMAL?
NO
YES
2
IS SIGNAL CORRECT?
YES
NO
CHECK:
1. A2CR1
2. A2Q2
3. A2Q3
4. A2Q4
CHECK A2CR11-K FOR NARROW PULSES ≈+ AND −9 V pk ON ≈+1 Vdc
71
NO
CHECK
ARE PULSES CORRECT?
YES
NO
CHECK A2Q12 AND A2Q11
CHECK A2-1 FOR BLANKING PULSE ≈+20 V pk
75
IS BLANKING PULSE CORRECT?
YES
NO
CHECK A2Q13
CHECK A2CR5-K FOR WIDE PULSES ≈+20 V pk
76
NO
CHEC
IS SWEEP RAMP CORRECT?
YES
NO
CHECK:
1. A2Q7
2. A2Q8
3. A2Q9
4. A2Q10
SET TRIG TO MANUAL AND PRESS MANUAL PUSHBUTTON. CHECK A2-6 FOR 0 TO +10 V SWEEP RAMP
80
IS A SINGLE SWEEP RAMP GENERATED WHEN BUTTON IS PRESSED?
YES
NO
CHECK:
1. S5
2. R18
3. S4
4. A9R8
SET TRIG TO RECUR. CHECK A2-6 FOR 0 TO +10 V SWEEP RAMP
81
NO
CHECK
1. S4
2. A2CR2
3. A9R8
4. CR2
5. R4

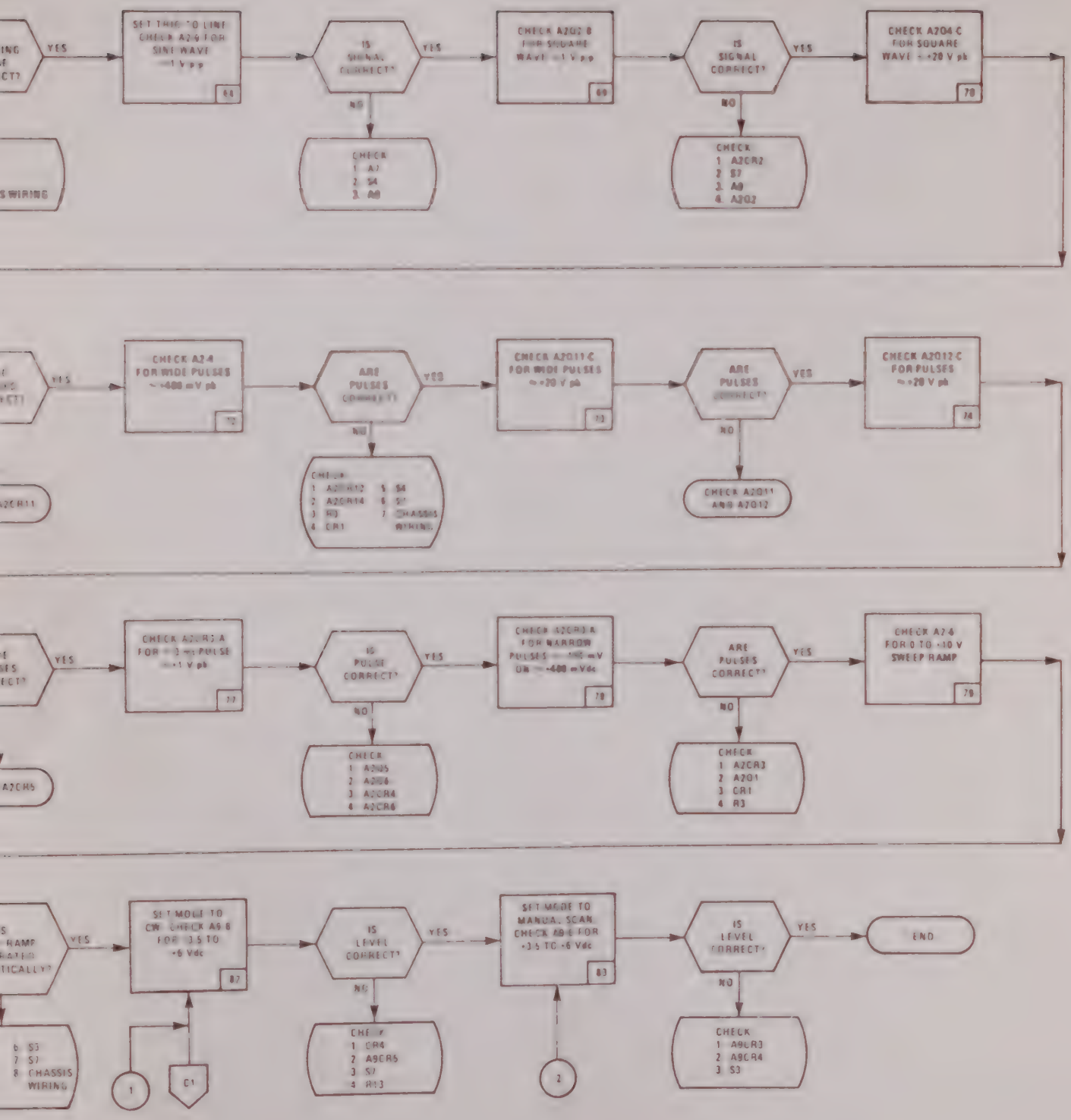
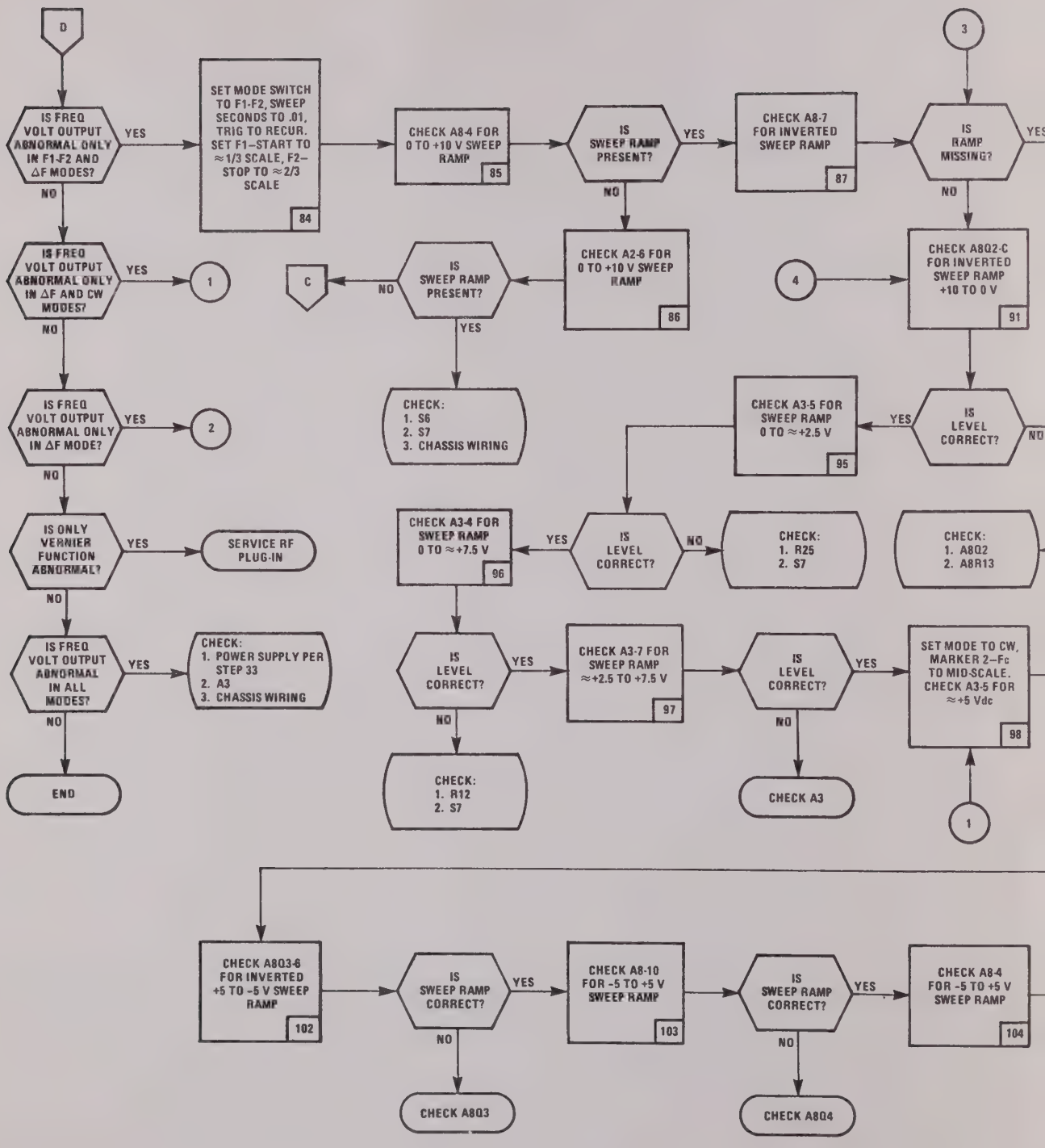


Figure 6-1. Troubleshooting Diagram (Sheet 6)


D
IS FREQ VOLT OUTPUT ABNORMAL ONLY IN F1-F2 AND ΔF MODES?
YES
NO
SET MODE SWITCH TO F1-F2, SWEEP SECONDS TO .01, TRIG TO RECUR. SET F1–START TO ≈1/3 SCALE, F2–STOP TO ≈2/3 SCALE
84
CHECK A8-4 FOR 0 TO +10 V SWEEP RAMP
85
IS SWEEP RAMP PRESENT?
YES
NO
CHECK A8-7 FOR INVERTED SWEEP RAMP
87
3
IS RAMP MISSING?
YES
NO
IS FREQ VOLT OUTPUT ABNORMAL ONLY IN ΔF AND CW MODES?
YES
1
NO
C
IS SWEEP RAMP PRESENT?
NO
YES
CHECK A2-6 FOR 0 TO +10 V SWEEP RAMP
86
4
CHECK A8Q2-C FOR INVERTED SWEEP RAMP +10 TO 0 V
91
IS FREQ VOLT OUTPUT ABNORMAL ONLY IN ΔF MODE?
YES
2
NO
CHECK:
1. S6
2. S7
3. CHASSIS WIRING
CHECK A3-5 FOR SWEEP RAMP 0 TO ≈+2.5 V
95
YES
IS LEVEL CORRECT?
NO
IS ONLY VERNIER FUNCTION ABNORMAL?
YES
SERVICE RF PLUG-IN
NO
CHECK A3-4 FOR SWEEP RAMP 0 TO ≈+7.5 V
96
YES
IS LEVEL CORRECT?
NO
CHECK:
1. R25
2. S7
CHECK:
1. A8Q2
2. A8R13
IS FREQ VOLT OUTPUT ABNORMAL IN ALL MODES?
YES
CHECK:
1. POWER SUPPLY PER STEP 33
2. A3
3. CHASSIS WIRING
NO
END
IS LEVEL CORRECT?
YES
NO
CHECK:
1. R12
2. S7
CHECK A3-7 FOR SWEEP RAMP ≈+2.5 TO +7.5 V
97
IS LEVEL CORRECT?
YES
NO
CHECK A3
SET MODE TO CW, MARKER 2–Fc TO MID-SCALE. CHECK A3-5 FOR ≈+5 Vdc
98
1
CHECK A8Q3-6 FOR INVERTED +5 TO –5 V SWEEP RAMP
102
IS SWEEP RAMP CORRECT?
YES
NO
CHECK A8Q3
CHECK A8-10 FOR –5 TO +5 V SWEEP RAMP
103
IS SWEEP RAMP CORRECT?
YES
NO
CHECK A8Q4
CHECK A8-4 FOR –5 TO +5 V SWEEP RAMP
104

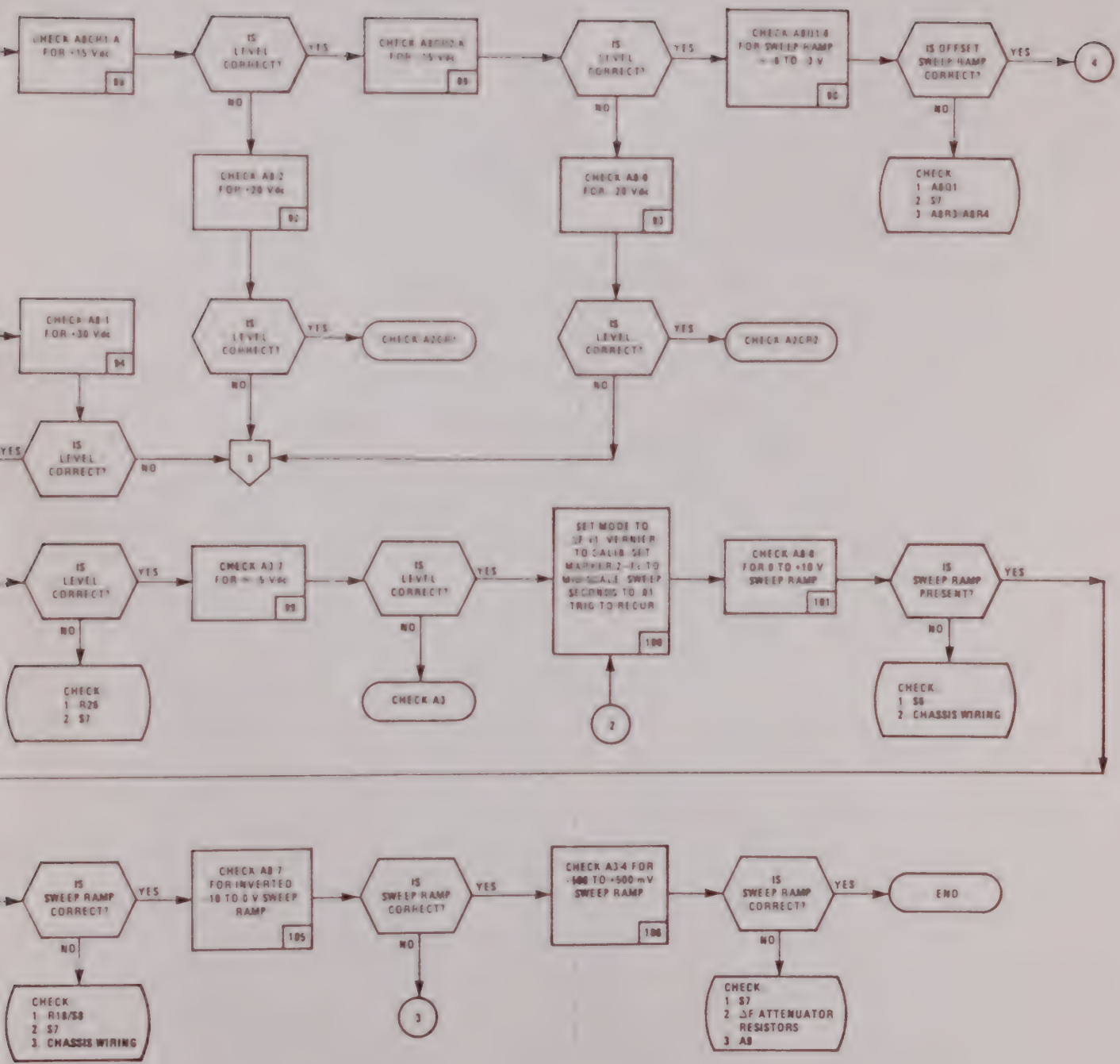
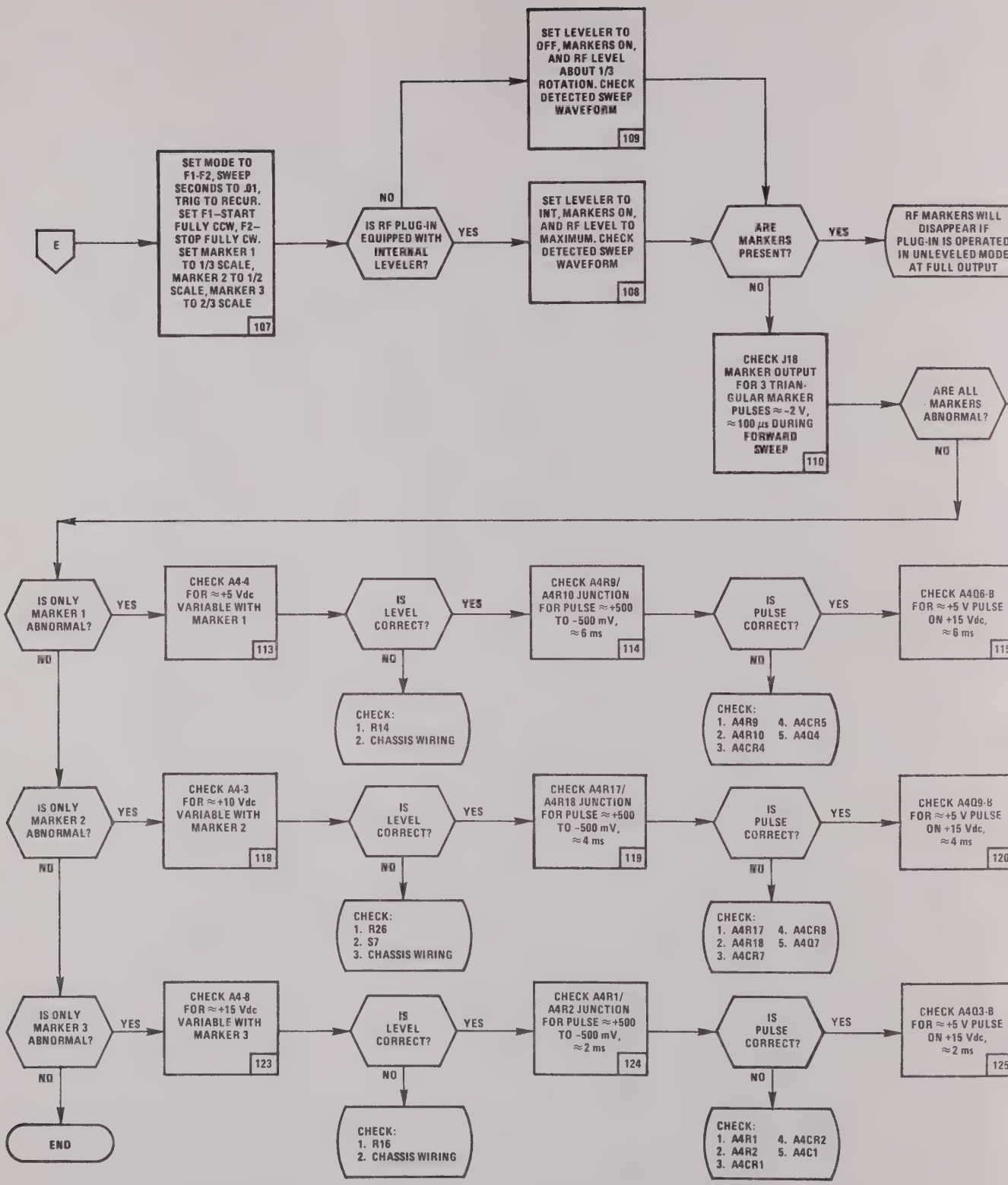


Figure 6-1. Troubleshooting Diagram (Sheet 7)


E
SET MODE TO F1-F2, SWEEP SECONDS TO .01, TRIG TO RECUR. SET F1–START FULLY CCW, F2–STOP FULLY CW. SET MARKER 1 TO 1/3 SCALE, MARKER 2 TO 1/2 SCALE, MARKER 3 TO 2/3 SCALE
107
IS RF PLUG-IN EQUIPPED WITH INTERNAL LEVELER?
NO
YES
SET LEVELER TO OFF, MARKERS ON, AND RF LEVEL ABOUT 1/3 ROTATION. CHECK DETECTED SWEEP WAVEFORM
109
SET LEVELER TO INT, MARKERS ON, AND RF LEVEL TO MAXIMUM. CHECK DETECTED SWEEP WAVEFORM
108
ARE MARKERS PRESENT?
YES
RF MARKERS WILL DISAPPEAR IF PLUG-IN IS OPERATED IN UNLEVELED MODE AT FULL OUTPUT
NO
CHECK J18 MARKER OUTPUT FOR 3 TRIANGULAR MARKER PULSES ≈ -2 V, ≈ 100 µs DURING FORWARD SWEEP
110
ARE ALL MARKERS ABNORMAL?
NO
IS ONLY MARKER 1 ABNORMAL?
YES
NO
CHECK A4-4 FOR ≈ +5 Vdc VARIABLE WITH MARKER 1
113
IS LEVEL CORRECT?
YES
NO
CHECK:
1. R14
2. CHASSIS WIRING
CHECK A4R9/ A4R10 JUNCTION FOR PULSE ≈ +500 TO -500 mV, ≈ 6 ms
114
IS PULSE CORRECT?
YES
NO
CHECK:
1. A4R9
2. A4R10
3. A4CR4
4. A4CR5
5. A4Q4
CHECK A4Q6-B FOR ≈ +5 V PULSE ON +15 Vdc, ≈ 6 ms
IS ONLY MARKER 2 ABNORMAL?
YES
NO
CHECK A4-3 FOR ≈ +10 Vdc VARIABLE WITH MARKER 2
118
IS LEVEL CORRECT?
YES
NO
CHECK:
1. R26
2. S7
3. CHASSIS WIRING
CHECK A4R17/ A4R18 JUNCTION FOR PULSE ≈ +500 TO -500 mV, ≈ 4 ms
119
IS PULSE CORRECT?
YES
NO
CHECK:
1. A4R17
2. A4R18
3. A4CR7
4. A4CR8
5. A4Q7
CHECK A4Q9-B FOR ≈ +5 V PULSE ON +15 Vdc, ≈ 4 ms
IS ONLY MARKER 3 ABNORMAL?
YES
NO
END
CHECK A4-8 FOR ≈ +15 Vdc VARIABLE WITH MARKER 3
123
IS LEVEL CORRECT?
YES
NO
CHECK:
1. R16
2. CHASSIS WIRING
CHECK A4R1/ A4R2 JUNCTION FOR PULSE ≈ +500 TO -500 mV, ≈ 2 ms
124
IS PULSE CORRECT?
YES
NO
CHECK:
1. A4R1
2. A4R2
3. A4CR1
4. A4CR2
5. A4C1
CHECK A4Q3-B FOR ≈ +5 V PULSE ON +15 Vdc, ≈ 2 ms

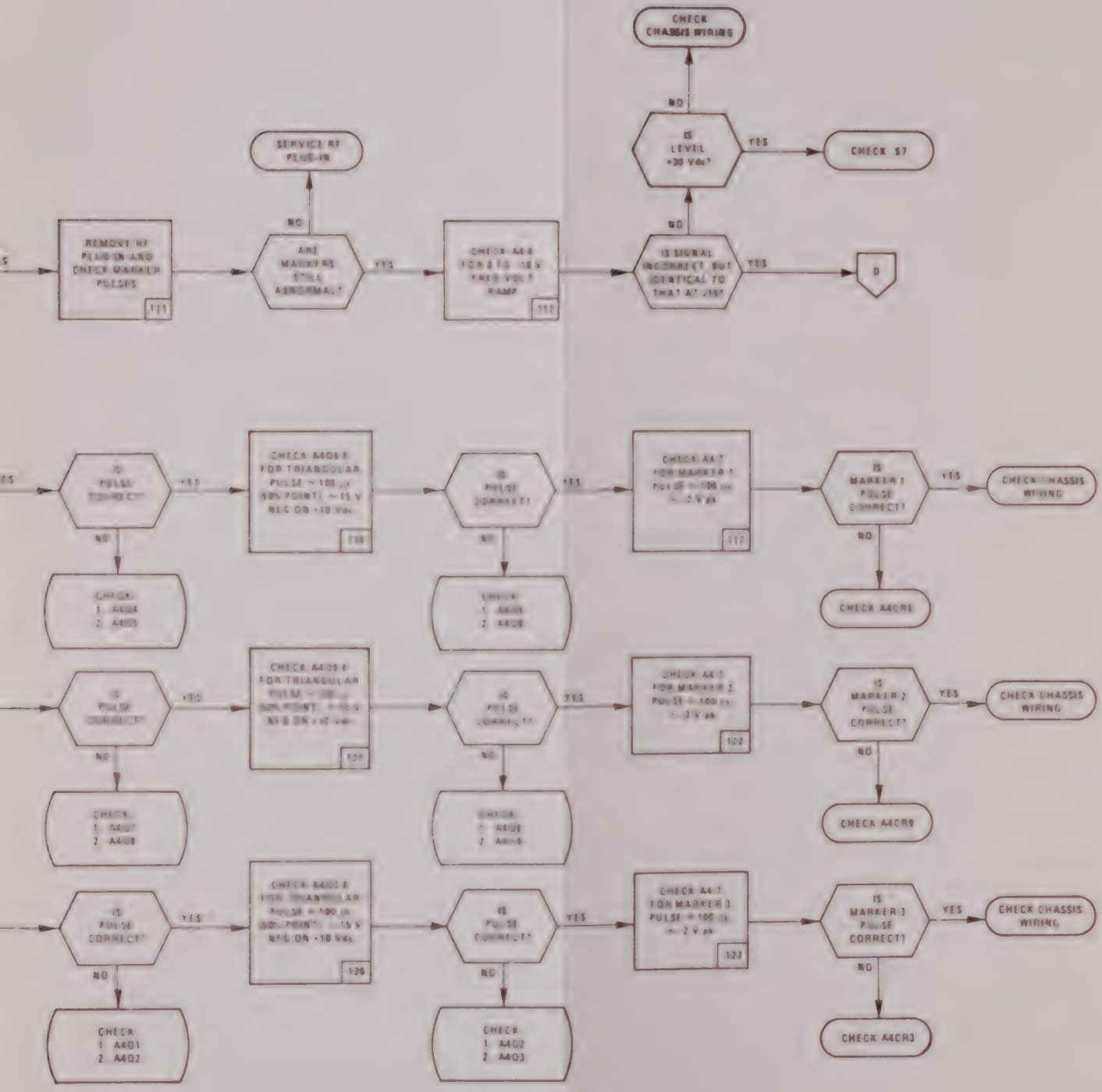


Figure 6-1. Troubleshooting Diagram (Sheet 8)

SECTION VII

REPLACEABLE PARTS LISTS

7-1. INTRODUCTION

This section contains replaceable parts lists for the Model 5000A Sweeper Mainframe.

7-2. ORDERING REPLACEMENT PARTS

The majority of the electronic parts used in the 5000A are standard distributor items and should be available locally. To order special replacement parts and parts which are not otherwise obtainable, write to Systron-Donner Corporation at the address shown at the front of this manual, or contact your local Scientific Devices office.

Be sure to include the model number (5000A, 5000AM1, etc.) and serial number of the unit for which parts are required. Please order by Systron-Donner part number; also include the reference designator where applicable.

7-3. EXPLANATION OF COLUMNS

7-3.1 Fig. No./Item No.

This column references the figure numbers in which the part can be located and the parts location reference number in the parts breakdown drawing.

7-3.2 Ref. Desig.

Electronic parts are listed in sequence by reference designation and may be located on the schematic diagram by this designator. Reference designators for components not available separately, which may be ordered only as part of another subassembly, are listed in *italic type.*

7-3.3 Use Code

An entry in this column indicates that the part may not be found in all 5000A's because it is part of an option, a part replaced when an option is ordered, or an alternate part. Table 7-1 lists the use codes for Model 5000A.

7-3.4 Systron-Donner Part Number

All standard parts manufactured by Systron-Donner or manufactured to Systron-Donner specifications are listed in this column, but not in the *MFR'S PART NUMBER* column. All other purchased parts which have been assigned Systron-Donner part numbers are also listed in this column. These part numbers must be used when ordering parts.

7-3.5 Mfr's Part Number

Commercially-available parts not manufactured by Systron-Donner or to Systron-Donner specifications are listed in this column. Insofar as possible, these part numbers are complete. For best results, always include a complete part description as well as the listed manufacturer's part number when ordering replacement parts from manufacturers or distributors.

Table 7-1. Model 5000A Use Codes

CODE	EXPLANATION
A	Alternate part; used when part listed is interchangeable with primary part
E	Component is part of referenced assembly and is not available separately
F	Component supplied to Systron-Donner Microwave Division specifications. *Manufacturer's standard part may not meet 5000A performance specifications unless screened by Microwave Division incoming inspection*
H	Modified part; physical alteration required from standard part as supplied by manufacturer before use in 5000A
M	Component supplied as part of Option M1, M3, or M10
P	Primary part; used when part listed may be replaced by an alternate part
T	Component size or electrical value is chosen by test as part of a calibration procedure

7-3.6 Mfr. Code

The five-digit Federal Manufacturers' Codes, as listed in Cataloging Handbooks H4-1 and H4-2, are listed in this column. These codes and corresponding manufacturers are listed in Table 7-2.

7-3.7 Description

Descriptions of component parts of subassemblies are indented to indicate the parts comprising each subassembly.

7-3.8 Qty.

The quantity of the listed part used in a particular application is listed in this column. For example, if four screws are used to mount a subassembly, the number "4" is entered in this column, even if all four of the screws are not shown on the drawing. If two screws identical to these are used elsewhere in the chassis to mount another subassembly, the part will be listed again with the number "2" entered in the *QTY* column. If the same type of screw is to be used to mount an optional component, the screw will be listed a third time with "1" entered in the *QTY* column and the appropriate use coding letter in the *USE CODE* column.

7-4. PARTS BREAKDOWN

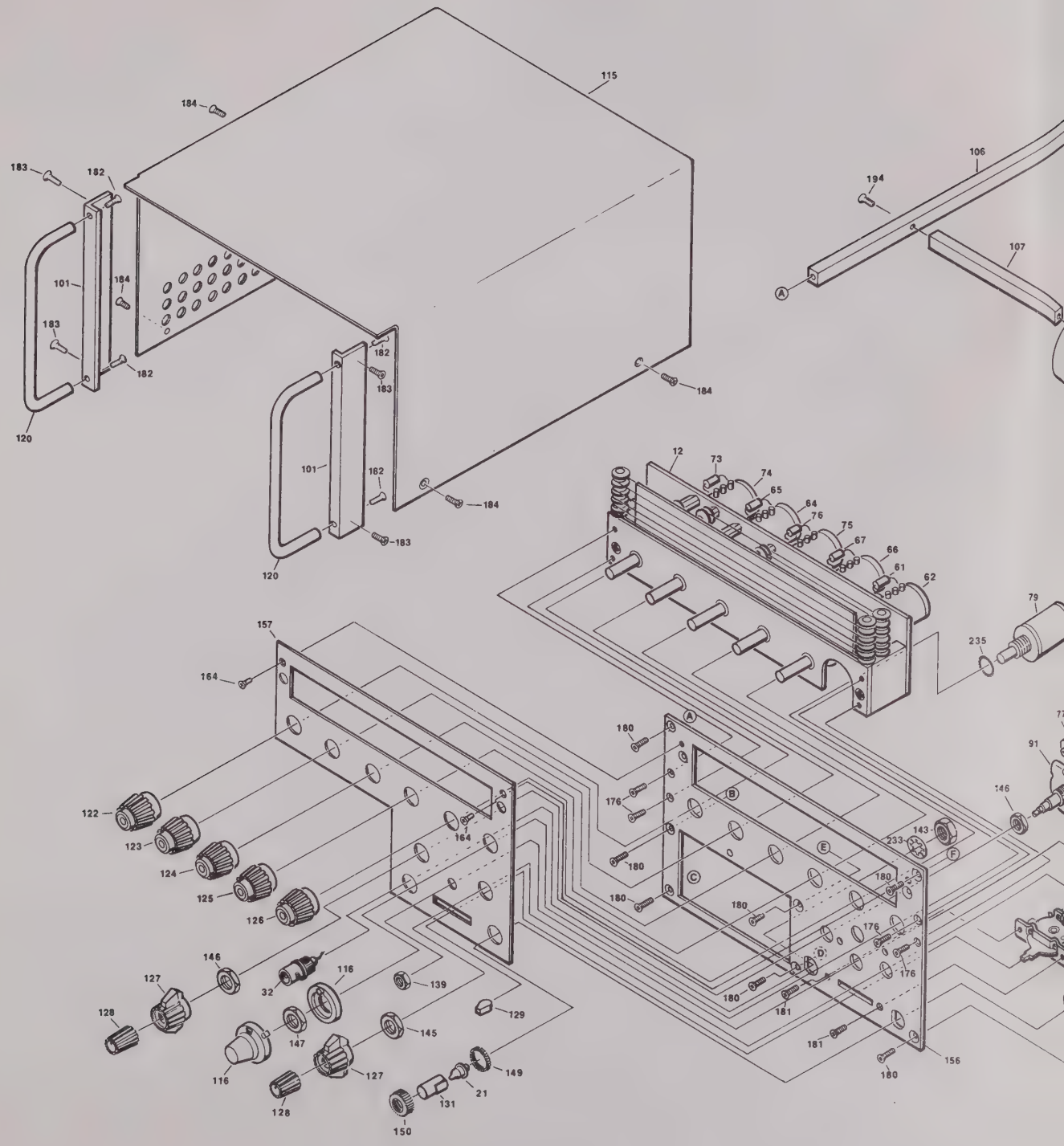
Figure 7-1 is the illustrated parts breakdown for all current versions of the 5000A; the item numbers shown are used to locate the parts description in the chassis parts list. The figure may also be used as a disassembly and reassembly guide.

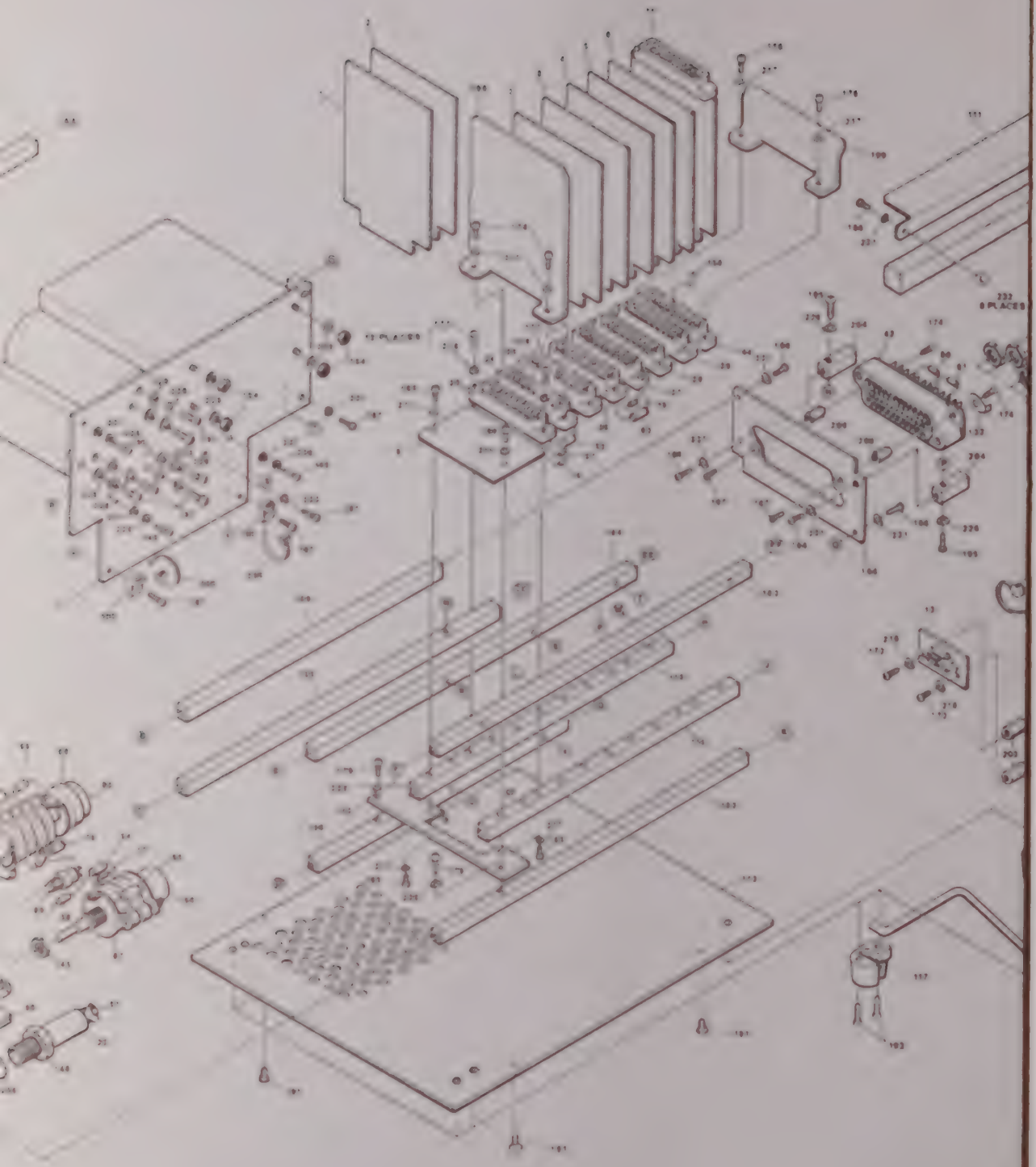
Table 7-2. Manufacturers' Codes

CODE	NAME
01121	Allen Bradley Co., Milwaukee, WI 53204
01139	General Electric Co., Silicone Products Division, Waterford, NY 12188
01220	Systron-Donner Corp., Microwave Division, Van Nuys, CA 91411
01295	Texas Instruments, Inc., Dallas, TX 75222
02660	Bunker-Ramo Corp., Connector Division, Broadview, IL 60153
02735	RCA Corp., Solid State Division, Sommerville, NJ 08876
03494	General Electric Co., Schenectedy, NY 12305
03508	General Electric Co., Semiconductor Products Dept., Syracuse, NY 13201
04713	Motorola, Inc., Semiconductor Products Division, Phoenix, AZ 85036
06383	Panduit Corporation, Tinley Park, IL 60477
07233	TRW Electronic Components, Cinch-Graphix, City of Industry, CA 91744
08806	General Electric Co., Miniature Lamp Products, Cleveland, OH 44112
09969	Dale Electronics, Columbus, NE 68601
11534	Duncan Electronics, Inc., Costa Mesa, CA 92626
12954	Siemens Corporation, Components Group, Scottsdale, AZ
14655	Cornell-Dubilier, Division of Federal Pacific Electric Co., Newark, NJ
14674	Corning Glass Works, Bradford, PA 16701
14752	Electro-Cube, Inc., San Gabriel, CA 91776
16428	Belden Corp., Electronic Division, Richmond, IN
17474	Tranex, Inc., Mountain View, CA 94043
18714	RCA Solid State Division, Findlay, OH
22229	Union Carbide Corporation, Linde Division, Mountain View, CA 94040
23936	William J. Purdy Co., Pamotor Division, Burlingame, CA 94010
27014	National Semiconductor Corp., Santa Clara, CA

Table 7-2. Manufacturers' Codes (Continued)

CODE	NAME
56289	Sprague Products Co., North Adams, MA
71002	Birnbach Co., Inc., Freeport, NY 11520
71400	McGraw-Edison Co., Bussman Mfg. Division, St. Louis, MO 63107
71590	Globe-Union, Inc., Centralab Division, Milwaukee, WI
72136	Electro Motive Manufacturing Co., Inc., Willimantic, CT
73734	Federal Screw Products, Inc., Chicago, IL 60618
74868	Bunker-Ramo Corp., Amphenol RF Division, Danbury, CT 06810
75042	TRW, Inc., Philadelphia Division, Philadelphia, PA 19108
75915	Littelfuse, Inc., Des Plaines, IL
76854	Oak Industries, Inc., Switch Division, Crystal Lake, IL 60014
79963	Zierick Manufacturing Co., Mt. Kisco, NY 10549
80740	Beckman Instruments, Inc., Fullerton, CA 92634
81073	Grayhill, Inc., La Grange, IL 60525
82389	Switchcraft, Inc., Chicago, IL 60630
83330	Herman H. Smith Co., Inc., Brooklyn, NY 11207
88245	Litton Industries, Useco Division, Van Nuys, CA 91409
91827	K-F Development Co., Redwood City, CA 94063
99392	Mepco/Electra, Inc., Oakland, CA 94601


115
184
183
182
101
120
106
194
107
12
73
74
65
64
76
75
67
66
61
62
79
235
157
164
180
176
91
146
143
233
122
123
124
125
126
127
128
32
116
139
129
145
147
149
131
21
150
156
181



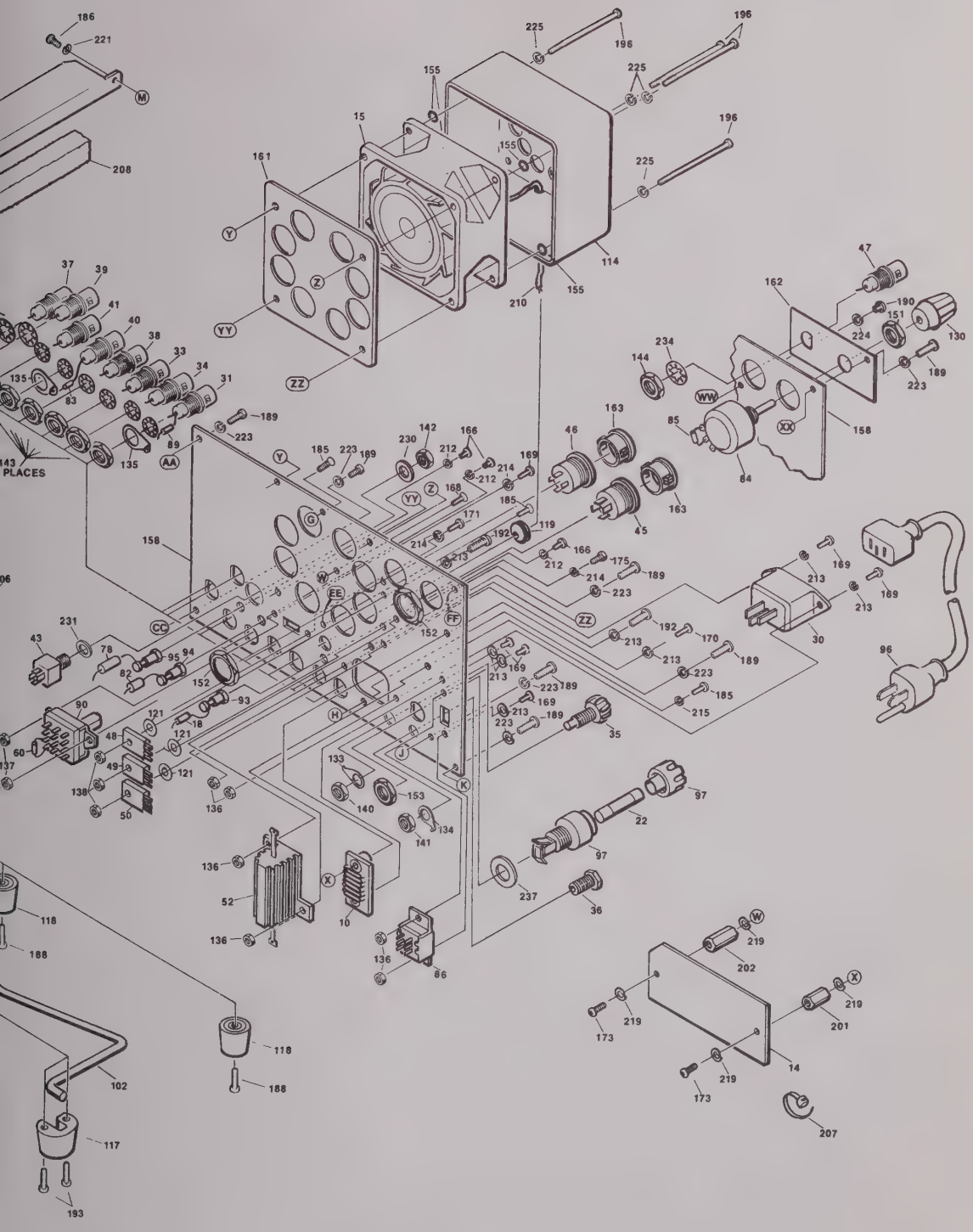


Figure 7-1. Model 5000A Illustrated Parts Breakdown

Table 7-3. Model 5000A Chassis Parts List

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION	QTY
7-1							
1	A1		950001		01220	BOARD ASSY — TIMING CAPACITOR	1
2	A2		950278		01220	BOARD ASSY — TRIGGER-SWEEP	1
3	A3		950299		01220	BOARD ASSY — SINGLE OPERATIONAL AMPLIFIER	1
4	A4		950004		01220	BOARD ASSY — TRIPLE MARKER GENERATOR	1
5	A5		950215		01220	BOARD ASSY — DUAL PRECISION REGULATOR	1
6	A6		950214		01220	BOARD ASSY — SINGLE PRECISION REGULATOR	1
7	A7		950218		01220	BOARD ASSY — POWER SUPPLY	1
8	A8		950216		01220	BOARD ASSY — DUAL OPERATIONAL AMPLIFIER	1
9	A9		950168		01220	BOARD ASSY — SWEEP-SECOND	1
10	A10		950217		01220	BOARD ASSY — OVERCURRENT LIMIT	1
11	A11		950007		01220	BOARD ASSY — EXTENDER	1
12	A12		950014		01220	DIAL ASSEMBLY	1
13	A13	M1	950025		01220	BOARD ASSEMBLY — BLANKING INVERTER	1
14	A14	M3	950269		01220	BOARD ASSEMBLY — POSITIVE REFERENCE OUTPUT	1
15	B1	S	100887	8500	23936	FAN, 47—63 Hz	1
15	B1	A	108276	8124	23936	FAN, 28 Vdc	1
16	CR1		105532	1N4446	03494	DIODE, Silicon, 75 PIV	1
17	CR2		105532	1N4446	03494	DIODE, Silicon, 75 PIV	1
18	CR3		105532	1N4446	03494	DIODE, Silicon, 75 PIV	1
19	CR4		105533	1N4749A	12954	DIODE, Zener, 24 V ±5%, 1 W	1
20	DS1		105700	616-6-1-AIH	76854	SWITCH, Pushbutton (PUSH ON-OFF) Includes:	1
21	I1		105296	BAI-H	76854	LAMP, Neon	1
					76854	LENS, Indicator, red	1
					76854	NUT, Dress	1
					76854	NUT, Knurled	1
					76854	NUT, Mounting	1
					76854	WASHER, Lock	1
22	F1	S	100584	313001	75915	FUSE, Slow Blowing, 1 A (115 V)	1
22	F1	A	100589	MDL 1/2	71400	FUSE, Slow Blowing, 1/2 A (230 V)	1
—	*I1*					*Part of DS1*	
23	J1		104199	250 10 30 170	07233	CONNECTOR, Receptacle, 10 pin female	1
24	J2		104199	250 10 30 170	07233	CONNECTOR, Receptacle, 10 pin female	1
25	J3		104199	250 10 30 170	07233	CONNECTOR, Receptacle, 10 pin female	1
26	J4		104199	250 10 30 170	07233	CONNECTOR, Receptacle, 10 pin female	1
27	J5		104199	250 10 30 170	07233	CONNECTOR, Receptacle, 10 pin female	1
28	J6		104199	250 10 30 170	07233	CONNECTOR, Receptacle, 10 pin female	1
29	J7		104199	250 10 30 270	07233	CONNECTOR, Receptacle, 10 pin female	1
30	J8	P	101288	EAC-301	82389	CONNECTOR, Receptacle, line power (IEC)	1
30	J8	A	104241	AC3G	82389	CONNECTOR, Receptacle, line power	1
31	J9		101155	UG-1094/U	74868	CONNECTOR, Receptacle, BNC (EXT'L TRIG)	1
32	J10		101155	UG-1094/U	74868	CONNECTOR, Receptacle, BNC (SWEEP OUTPUT)	1
33	J11		101155	UG-1094/U	74868	CONNECTOR, Receptacle, BNC (SWEEP OUTPUT)	1
34	J12		101155	UG-1094/U	74868	CONNECTOR, Receptacle, BNC (EXT'L SWEEP)	1
35	J13		104217	221-102	83330	JACK, Banana, red (+20 V)	1
36	J14		104216	101	83330	JACK, Banana, plain (GND)	1
37	J15		101155	UG-1094/U	74868	CONNECTOR, Receptacle, BNC (FREQ VOLT)	1
38	J16		101155	UG-1094/U	74868	CONNECTOR, Receptacle, BNC (BLANKING OUTPUT)	1
39	J17		101155	UG-1094/U	74868	CONNECTOR, Receptacle, BNC (EXT'L A.M.)	1
40	J18		101155	UG-1094/U	74868	CONNECTOR, Receptacle, BNC (MARKER OUTPUT)	1

Table 7-3. Model 5000A Chassis Parts List (Continued)

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION	QTY
41	J19		101155	UG-1094/U	74868	CONNECTOR, Receptacle, BNC (1 KHZ OUTPUT)	1
42	J20		102369	26-190-24S	02660	CONNECTOR, Receptacle, 24 pin female	1
43	J21		105701	142A	82389	CONNECTOR, Receptacle, miniature phone jack	1
44	J22		104199	250 10 30 170	97243	CONNECTOR, Receptacle, 10 pin female	1
45	J23	M10	104337	91-T-3363	02660	CONNECTOR, Receptacle, 5 pin female	1
46	J24	M19	104335	91-T-3478	02660	CONNECTOR, Receptacle, 7 pin female	1
47	J301	M3	101155	UG-1094/U	74868	CONNECTOR, Receptacle, BNC	1
48	Q1		106602	MJE 3055	04713	TRANSISTOR, NPN Silicon, Case 90	1
49	Q2		106602	MJE 3055	04713	TRANSISTOR, NPN Silicon, Case 90	1
50	Q3		106602	MJE 3055	04713	TRANSISTOR, NPN Silicon, Case 90	1
51	R1		104942	RCR05G563KS	01121	RESISTOR, Carbon, 56 kΩ ±10%, 1/8 W	1
52	R2		105470	RE70G100	02660	RESISTOR, Wirewound, 10 Ω ±3%, 25 W	1
53	R3		104886	RCR07G125KS	01121	RESISTOR, Carbon, 12 MΩ ±10%, 1/4 W	1
54	R4		104889	RL07S154G	14674	RESISTOR, Metal Film, 150 kΩ ±2%, 1/4 W	1
55	R5		104847	RL07S102G	14674	RESISTOR, Metal Film, 1000 Ω ±2%, 1/4 W	1
56	*R6*					*Part of S3*	
57	R7		104829	RL07S471G	14674	RESISTOR, Metal Film, 470 Ω ±2%, 1/4 W	1
58	R8		104885	RL07S104G	14674	RESISTOR, Metal Film, 100 kΩ ±2%, 1/4 W	1
59	R9		104877	RL07S473G	14674	RESISTOR, Metal Film, 47 kΩ ±2%, 1/4 W	1
60	R10		104744	C3-15-5	14674	RESISTOR, Metal Film, 15 Ω ±5%, 1/8 W	1
61	*R11*					*Part of A12*	
62	*R12*					*Part of A12*	
63	R13		104972	RCR105KS	01121	RESISTOR, Carbon, 1 MΩ ±10%, 1/4 W	1
64	*R14*					*Part of A12*	
65	*R15*					*Part of A12*	
66	*R16*					*Part of A12*	
67	*R17*					*Part of A12*	
68	*R18*					*Part of S7*	
69	R19		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W	1
70	R20		105883	BA6-10K	91827	RESISTOR, Wirewound, 10 kΩ ±0.1%, 1/4 W	1
71	R21		104703	RN55D1110F	14674	RESISTOR, Metal Film, 11 Ω ±1%, 1/8 W	1
	R22					Not used	
72	R23		104813	RL07S101G	14674	RESISTOR, Metal Film, 100 Ω ±2%, 1/4 W	1
73	*R24*					*Part of A12*	
74	*R25*					*Part of A12*	
75	*R26*					*Part of A12*	
76	*R27*					*Part of A12*	
77	R28		105364	BA6-25K	91827	RESISTOR, Wirewound, 25 kΩ ±0.1%, 1/4 W	1
78	R29		104918	RCR42G511J	01121	RESISTOR, Carbon, 510 Ω ±5%, 1 W	1
79	R30		105527	7246-R10KL	80140	RESISTOR, Variable, 10 kΩ, 10 turn (VERNIER)	1
80	R31		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W	1
81	R32		104873	RL07S330J	14674	RESISTOR, Metal Film, 33 kΩ ±2%, 1/4 W	1
82	R33		105006	RCR42G102KS	01121	RESISTOR, Carbon, 1000 Ω ±10%, 1 W	1
83	R34		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W	1
84	R301	M3	960057		01220	RESISTOR, Variable, 10 kΩ (FREQ REF VOLT)	1
85	R302	M3	104885	RL07S104G	14674	RESISTOR, Metal Film, 100 kΩ ±2%, 1/4 W	1
86	S1		102331	4625641.FR	82389	SWITCH, Slide, DPDT (115/230 V)	1
	S2					Not used	
87	S3		105696	5P5552	11237	SWITCH ASSY, 4 Pole, 5 position (SWEEP SECONDS)	1
						Includes	
	R6					RESISTOR, Variable, 10 kΩ ±10%	1
88	S4	F	960043		01220	SWITCH, Lever	1
89	S5		102413	30-1	81073	SWITCH, Pushbutton, red	1
90	S6		102473	50212L	82389	SWITCH, Slide, 4PDT	1
91	S7	F	962251		01220	SWITCH ASSY, 7 pole, 5 position (MODE)	1
						Includes	
	R18	E				RESISTOR, Variable, 500 Ω	1
						Includes	
	S8	E				SWITCH, SPST	1
92	*S8*					*Part of R8*	
93	TB1		104298	4551-4	88245	TERMINAL, Standoff	1
94	TB2		104298	4551-4	88245	TERMINAL, Standoff	1
95	TB3		104298	4551-4	88245	TERMINAL, Standoff	1
96	W1	P	105790	17252	16428	CORD SET, Power, 3-wire (IEC)	1
96	W1	A	105787	172585	16428	CORD SET, Power, 3-wire	1
97	XF1		102409	342004	75915	HOLDER, Fuse, 3 AG size	1

Table 7-3. Model 5000A Chassis Parts List (Continued)

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION	QTY
98						Not used	
99						Not used	
100			105797	TM-1S6M	06383	ANCHOR, Strap, nylon no. 6	2
101			928477		01220	ANGLE, Corner	2
102			100906	MP40008-2	21604	BAIL	1
						Includes:	
			113169	DP40012-1	21604	FOOT, Front, left	1
			113168	DP40012-2	21604	FOOT, Front, right	1
103			92800301		01120	BAR, Chassis	2
104			92800302		01220	BAR, Chassis	1
105			92800306		01220	BAR, Mounting	1
106			92800308		01220	BAR, Chassis Corner	1
107			928461		01220	BAR, Support, power supply	1
108			92800202		01220	BAR, Mounting, connector plate	1
109			92800203		01220	BAR, Mounting, connector plate	1
110			92800201		01220	BAR, Connector Mounting	2
111			928911		01220	BRACKET, Retainer, P.C. board	1
						Includes:	
			321250			TAPE, Foam	
112			922005		01220	BRACKET, Support	1
113			91600501		01220	COVER, Bottom	1
114			922148		01220	COVER, Fan	1
115			916006		01220	COVER, Top	1
116			104418	2606	80740	DIAL, Turn-counting	1
117				Supplied with Item 102	21604	FOOT, Front	2
118			113170	PP40013	21604	FOOT, Rear	2
119			104552	2147	83330	GROMMET, Vinyl, 1/4 in. I.D.	1
120			104409	10235-8-0632-4	06540	HANDLE, 4-1/2 in.	2
121			105626	DF103D	02735	INSULATOR, Transistor, mica	3
122			94802202		01220	KNOB, Gold Insert (F1-START)	1
123			94802204		01220	KNOB, Green Insert (MARKER 1)	1
124			94802201		01220	KNOB, Red Insert (MARKER 2—Fc)	1
125			94802203		01220	KNOB, Blue Insert (MARKER 3)	1
126			94802205		01220	KNOB, Orange Insert (F2-STOP)	1
127			960007		01220	KNOB, Pointer	2
128			960019		01220	KNOB, Red	2
129			960010		01220	KNOB, Lever Switch	1
130		M3	960057		01220	KNOB, Black	1
131				Supplied with DS1	76854	LENS, Indicator, red	1
132			100509	1416-4	83330	LUG, Solder, no. 4	1
133				Supplied with J13	83330	LUG, Solder, 5/16 in.	1
134		P		Supplied with J14	83330	LUG, Solder, 5/16 in.	1
135			104262	1497	83330	LUG, Solder, 3/8 in.	2
136			100941	511-041800-00	78189	NUT, Kep, 4-40	6
137		S	100941	511-041800-00	78189	NUT, Kep, 4-40	2
138			100638	NAS671C6		NUT, 6-32 x 3/16	3
139				Supplied with S5	81073	NUT, 1/4 in.	1
140				Supplied with J13	83330	NUT, 5/16 in.	1
141				Supplied with J14	83330	NUT, 5/16 in.	1
142				Supplied with J21	82389	NUT, 5/16 in.	1
143				Supplied with J9—J12 and J15—J19	74868	NUT, 3/8-32	9
144		M3		Supplied with J301	74868	NUT, 3/8-32	1
145				Supplied with S3	11237	NUT, 1/2 in.	2
146				Supplied with S7	01220	NUT, 1/2 in.	2
147				Supplied with R30	80740	NUT, 1/2 in.	1
148				Supplied with DS1	76854	NUT, 1/2 in.	1
149				Supplied with DS1	76854	NUT, Knurled, 1/2 in.	1
150				Supplied with DS1	76854	NUT, Dress, 1/2 in.	1
151		M3		Supplied with R301	01220	NUT, 1/2 in.	1
152		M10		Supplied with J23&J24	02660	NUT, 11/16 in.	2
153				Supplied with XF1	75915	NUT, 5/8 in.	1
154	A7		100940	511-081800-00	78189	NUT, Kep, 8-32	4
155			104685		83330	O-RING, Vinyl, 5/32 I.D.	4

Table 7-3. Model 5000A Chassis Parts List (Continued)

FIG. NO / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION	QTY
156			950009		01220	PANEL, Back-up, front	1
157			915001		01220	PANEL, Front	1
158			916045		01220	PANEL, Rear	1
159			102653	PN50-PK	07263	PIN, Polarizing, connector	19
160			922116		01220	PLATE, Mounting, connector	1
161			922149		01220	PLATE, Fan Shield	1
162		M3	922113		01220	PLATE, Component Mounting	1
163		S	104536	P687	28520	PLUG, Button, 11/16 in.	2
164			1007003	NAS662CR3		SCREW, Flat Head Phillips, 2-56 x 3/16, 100°	2
165			1006 2603	MS51957-12		SCREW, Pan Head Phillips, 4-40 x 3/16	4
166			1006 2603	MS51957-12		SCREW, Pan Head Phillips, 4-40 x 3/16	3
167			10072004	MS24693C2		SCREW, Flat Head Phillips, 4-40 x 1/4, 100°	2
168		M3	10072004	MS24693C2		SCREW, Flat Head Phillips, 4-40 x 1/4, 100°	1
169			1006 2604	MS51957-13		SCREW, Pan Head Phillips, 4-40 x 1/4	5
170		S	1006 2604	MS51957-13		SCREW, Pan Head Phillips, 4-40 x 1/4	1
170		M3	1006 2608	MS51957-30		SCREW, Pan Head Phillips, 4-40 x 1/2	1
171			1006 2604	MS51957-13		SCREW, Pan Head Phillips, 4-40 x 1/4	2
172		M1	1006 2604	MS51957-13		SCREW, Pan Head Phillips, 4-40 x 1/4	2
173		M3	1006 2604	MS51957-13		SCREW, Pan Head Phillips, 4-40 x 1/4	2
174			1006 2605	MS51957-14		SCREW, Pan Head Phillips, 4-40 x 5/16	2
175			1006 2605	MS51957-14		SCREW, Pan Head Phillips, 4-40 x 5/16	2
176			10072006	NAS662CR6		SCREW, Flat Head Phillips, 4-40 x 3/8, 100°	4
177			1006 2606	MS51957-15		SCREW, Pan Head Phillips, 4-40 x 3/8	12
178			1006 2607	MS51957-16		SCREW, Pan Head Phillips, 4-40 x 7/16	4
179			1006 3203	MS51957-25		SCREW, Pan Head Phillips, 6-32 x 3/16	2
180			10073104	MS24693C24		SCREW, Flat Head Phillips, 6-32 x 1/4, 100°	7
181			10073105	MS24693C25		SCREW, Flat Head Phillips, 6-32 x 5/16, 100°	2
182			10073105	MS24693C25		SCREW, Flat Head Phillips, 6-32 x 5/16, 100°	4
183			10073105	MS24693C25		SCREW, Flat Head Phillips, 6-32 x 5/16, 100°	4
184			10073105	MS24693C25		SCREW, Flat Head Phillips, 6-32 x 5/16, 100°	4
185			10073105	MS24693C25		SCREW, Flat Head Phillips, 6-32 x 5/16, 100°	2
186			1006 3205	MS51957-27		SCREW, Pan Head Phillips, 6-32 x 5/16	6
187	A7		1006 3205	MS51957-27		SCREW, Pan Head Phillips, 6-32 x 5/16	4
188			1006 3205	MS51957-27		SCREW, Pan Head Phillips, 6-32 x 5/16	2
189			1006 3205	MS51957-27		SCREW, Pan Head Phillips, 6-32 x 5/16	6
190		M3	1006 3202	MS51957-24		SCREW, Pan Head Phillips, 6-32 x 1/8	1
191			104604			SCREW, Truss Head Phillips, 6-32 x 5/16	4
192			1006 3206	MS51957-28		SCREW, Pan Head Phillips, 6-32 x 3/8	3
193			1006 3206	MS51957-28		SCREW, Pan Head Phillips, 6-32 x 3/8	4
194			10073108	MS24693C28		SCREW, Flat Head Phillips, 6-32 x 1/2, 100°	1
195			1006 3208	MS51957-30		SCREW, Pan Head Phillips, 6-32 x 1/2	3
196			104596			SCREW, Pan Head Phillips, 6-32 x 2	4
197	A7		1006 4406	MS51958-61		SCREW, Pan Head Phillips, 10-32 x 3/8	6
198			922046		01220	SHIELD, Interstage	1
199			922051		01220	SHIELD, A.C.	1
200			104544	8402	83330	SPACER, Hexagonal, 4-40 x 3/8	2
201		M3	104549		83330	SPACER, Hexagonal, 4-40 x 1/2	1
202		M3	960141		01220	SPACER, Hexagonal, 4-40 x 3/4	1
203		M1	104565	8405	83330	SPACER, Hexagonal, 4-40 x 3/4	2
204			92800101		01220	SPACER, Support	2
205			100753	SST 1	06383	STRAP, Nylon	30
206		M1	100753	SST 1	06383	STRAP, Nylon	6
207		M3	100753	SST 1	06383	STRAP, Nylon	4
208				Part of Item 111	01220	TAPE, Foam	1
209						TUBING, Heat Shrink, 1/8 in. I.D.	A/R
210				Supplied with B1	23939	TUBING, Insulating	6"
211			100711	MS35338-135		WASHER, Split Lock, no. 4	4
212			100711	MS35338-135		WASHER, Split Lock, no. 4	3
213			100711	MS35338-135		WASHER, Split Lock, no. 4	6
214		M1	100711	MS35338-135		WASHER, Split Lock, no. 4	2
215			100711	MS35338-135		WASHER, Split Lock, no. 4	2
216			100711	MS35338-135		WASHER, Split Lock, no. 4	12
217			100711	MS35338-135		WASHER, Split Lock, no. 4	4
218		M1	100711	MS35338-135		WASHER, Split Lock, no. 4	2
219		M3	100711	MS35338-135		WASHER, Split Lock, no. 4	4
220			100712	MS35338-136		WASHER, Split Lock, no. 6	2
221			100712	MS35338-136		WASHER, Split Lock, no. 6	6
222			100712	MS35338-136		WASHER, Split Lock, no. 6	2
223			100712	MS35338-136		WASHER, Split Lock, no. 6	6

Table 7-3. Model 5000A Chassis Parts List (Continued)

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION	QTY
224		M3	100712	MS35338-136		WASHER, Split Lock, no. 6	1
225			100712	MS35338-136		WASHER, Split Lock, no. 6	4
226	A7		100647	MS35333-71		WASHER, Lock, no. 6	3
227	A7		113185	MS15795-805		WASHER, Flat, no. 6	3
228	A7		100698	MS35333-73		WASHER, Lock, no. 10	6
229	A7		100648	MS15795-808		WASHER, Flat, no. 10	10
230			104530	2165	83330	WASHER, Flat Fibre, 1/4 in. I.D.	1
231			104524		01220	WASHER, Nylon. 0.281 in. I.D.	1
232				Supplied with J9, J11, J12, J15—J19	89709	WASHER, Lock, 3/8 in. I.D.	8
233				Supplied with J10	89709	WASHER, Lock, 3/8 in. I.D.	1
234		M3		Supplied with J301	89709	WASHER, Lock, 3/8 in. I.D.	1
235				Supplied with R30	80740	WASHER, Lock, 3/8 in. I.D.	1
236				Supplied with DS1	76854	WASHER, Lock, 1/2 in. I.D.	1
237				Supplied with XF1	75915	WASHER, Rubber, 5/8 in. I.D.	1

Table 7-4. Timing Capacitor Board Assembly A1 Parts List

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION
8-4	A1		950001		01220	BOARD ASSY — TIMING CAPACITOR Consisting of:
	A1C1		104156	212A1C103J	14752	CAPACITOR, Mylar, .01 μF ±5%, 200 V
	A1C2		104157	212A1C104J	14752	CAPACITOR, Mylar, 0.1 μF ±5%, 200 V
	A1C3		104158	212A1C105J	14752	CAPACITOR, Mylar, 1 μF ±5%, 200 V
	A1C4		104159	212A1C106J	14752	CAPACITOR, Mylar, 10 μF ±5%, 200 V
			936030		01220	BOARD, Printed Circuit

Table 7-5. Trigger-Sweep Board Assembly A2 Parts List

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION
8-5	A2		950278		01220	BOARD ASSY – TRIGGER-SWEEP Consisting of:
	A2C1		100221	DM15-471J	72136	CAPACITOR, Mica, 470 pF ±5%, 500 V
	A2C2		104147	192P1039R8	56289	CAPACITOR, Mylar, .01 μF ±10%, 80 V
	A2C3		100137	192P10292	56289	CAPACITOR, Mylar, .001 μF ±10%, 200 V
	A2CR1		105539	1N3716	08806	DIODE, Tunnel, 4.7 mA/50 pF
	A2CR2		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2CR3		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2CR4		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2CR5		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2CR6		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2CR7		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2CR8		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2CR9		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2CR10		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2CR11		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2CR12		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2CR13		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2CR14		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2Q1	F	105677	3N138	02735	TRANSISTOR, Field Effect, TO-18
	A2Q2		105652	2N2102	18714	TRANSISTOR, NPN Silicon, TO-5
	A2Q3		105653	2N2636	01295	TRANSISTOR, PNP Germanium, TO-18
	A2Q4		105652	2N2102	18714	TRANSISTOR, NPN Silicon, TO-5
	A2Q5	T	019420	2N5179	02735	TRANSISTOR, NPN Silicon
	A2Q6		105673	2N5087	04713	TRANSISTOR, PNP Silicon, TO-92
	A2Q7		105654	2N3391	01139	TRANSISTOR, NPN Silicon, R-67
	A2Q8		105654	2N3391	01139	TRANSISTOR, NPN Silicon, R-67
	A2Q9		105673	2N5087	04713	TRANSISTOR, PNP Silicon, TO-92
	A2Q10	T	113217	2N2102	18714	TRANSISTOR, NPN Silicon, TO-5
	A2Q11		105652	2N2102	18714	TRANSISTOR, NPN Silicon, TO-5
	A2Q12		105652	2N2102	18714	TRANSISTOR, NPN Silicon, TO-5
	A2Q13		105652	2N2102	18714	TRANSISTOR, NPN Silicon, TO-5
	A2R1		104863	RL07S123G	14674	RESISTOR, Metal Film, 12 kΩ ±2%, 1/4 W
	A2R2		104853	RL07S472G	14674	RESISTOR, Metal Film, 4700 Ω ±2%, 1/4 W
	A2R3		104849	RL07S332G	14674	RESISTOR, Metal Film, 3300 Ω ±2%, 1/4 W
	A2R4		104813	RL07S101G	14674	RESISTOR, Metal Film, 100 Ω ±2%, 1/4 W
	A2R5		104867	RL07S183G	14674	RESISTOR, Metal Film, 18 kΩ ±2%, 1/4 W
	A2R6		104853	RL07S472G	14674	RESISTOR, Metal Film, 4700 Ω ±2%, 1/4 W
	A2R7		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A2R8		104963	RCR07G224KS	01121	RESISTOR, Carbon, 220 kΩ ±10%, 1/4 W
	A2R9		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A2R10		104889	RL07S154G	14674	RESISTOR, Metal Film, 150 kΩ ±2%, 1/4 W
	A2R11		104963	RCR07G224KS	01121	RESISTOR, Carbon, 220 kΩ ±10%, 1/4 W
	A2R12		104692	RN60D1623F	75042	RESISTOR, Metal Film, 162 kΩ ±1%, 1/4 W
	A2R13		104844	RL07S202G	14674	RESISTOR, Metal Film, 2000 Ω ±2%, 1/4 W
	A2R14		104868	RL07S203G	14674	RESISTOR, Metal Film, 20 kΩ ±2%, 1/4 W
	A2R15		104885	RL07S104G	14674	RESISTOR, Metal Film, 100 kΩ ±2%, 1/4 W
	A2R16		104877	RL07S473G	14764	RESISTOR, Metal Film, 47 kΩ ±2%, 1/4 W
	A2R17		104966	RCR07G394KS	01121	RESISTOR, Carbon, 390 kΩ ±10%, 1/4 W
	A2R18		104853	RL07S472G	14674	RESISTOR, Metal Film, 4700 Ω ±2%, 1/4 W
	A2R19		104976	RCR07G335KS	01121	RESISTOR, Carbon, 3.3 MΩ ±10%, 1/4 W
	A2R20		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A2R21		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A2R22		104829	RL07S471G	14674	RESISTOR, Metal Film, 470 Ω ±2%, 1/4 W
	A2R23		104901	RL20S102G	14674	RESISTOR, Metal Film, 1000 Ω ±2%, 1/2 W
	A2R24		104865	RL07S153G	14674	RESISTOR, Metal Film, 15 kΩ ±2%, 1/4 W
	A2R25		105009	RCR32G391KS	01121	RESISTOR, Carbon, 390 Ω ±10%, 1 W
	A2R26		104725	RN70C1001F	56289	RESISTOR, Metal Film, 1000 Ω ±1%, 1/2 W
	A2R27		104845	RL07S222G	14674	RESISTOR, Metal Film, 2200 Ω ±2%, 1/4 W
	A2R28	T				RESISTOR, Value Selected at Test
	A2R29	T				RESISTOR, Value Selected at Test
	A2R30		104875	RL07S393G	14674	RESISTOR, Metal Film, 39 kΩ ±2%, 1/4 W
	A2R31		104877	RL07S473G	14674	RESISTOR, Metal Film, 47 kΩ ±2%, 1/4 W
	A2R32		104875	RL07S393G	14674	RESISTOR, Metal Film, 39 kΩ ±2%, 1/4 W
	A2R33		104843	RL07S182G	14674	RESISTOR, Metal Film, 1800 Ω ±2%, 1/4 W
	A2R34		104843	RL07S182G	14674	RESISTOR, Metal Film, 1800 Ω ±2%, 1/4 W

Table 7-5. Trigger-Sweep Board Assembly A2 Parts List (Continued)

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION
	A2R35		104875	RL07S393G	14674	RESISTOR, Metal Film, 39 kΩ ±2%, 1/4 W
	A2R36		104962	RCR07G184KS	01121	RESISTOR, Carbon, 180 kΩ ±10%, 1/4 W
	A2R37		104875	RL07S393G	14674	RESISTOR, Metal Film, 39 kΩ ±2%, 1/4 W
			105619	BHS-5 TO-5	71002	PAD, Transistor
			936090		01220	BOARD, Printed Circuit

Table 7-6. Single Operational Amplifier Board Assembly A3 Parts List

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION
8-6	A3		950299		01220	BOARD ASSY—SINGLE OPERATIONAL AMPLIFIER Consisting of:
	A3C1		104149	192P1049R8	56289	CAPACITOR, Mylar, 0.1 μF ±10%, 80 V
	A3C2		104147	192P1039R8	56289	CAPACITOR, Mylar, .01 μF ±10%, 80 V
	A3C3		100220	DM15-221J	72136	CAPACITOR, Mica, 220 pF ±5%, 500 V
	A3C4		100219	DM10-151J	72136	CAPACITOR, Mica, 150 pF ±5%, 500 V
	A3C5		104138	DM15-681J	72136	CAPACITOR, Mica, 680 pF ±5%, 300 V
	A3CR1		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A3CR2		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A3CR3		100443	1N4829	03508	DIODE, Signal, 20 PIV (1.87 V Fwd)
	A3Q1		105659	2N4045	22229	TRANSISTOR, Dual NPN Silicon, TO-5
	A3Q2		105673	2N5087	04713	TRANSISTOR, PNP Silicon, TO-92
	A3Q3		105673	2N5087	04713	TRANSISTOR, PNP Silicon, TO-92
	A3Q4		105652	2N2102	18714	TRANSISTOR, NPN Silicon, TO-5
	A3R1		104697	RN60D4753F	14674	RESISTOR, Metal Film, 475 kΩ ±1%, 1/4 W
	A3R2		105364	BA6-25K	91827	RESISTOR, Wirewound, 25 kΩ ±0.1%, 1/4 W
	A3R3		105364	BA6-25K	91827	RESISTOR, Wirewound, 25 kΩ ±0.1%, 1/4 W
	A3R4		105364	BA6-25K	91827	RESISTOR, Wirewound, 25 kΩ ±0.1%, 1/4 W
	A3R5		104863	RL07S123G	14674	RESISTOR, Metal Film, 12 kΩ ±2%, 1/4 W
	A3R6		104889	RL07S154G	14674	RESISTOR, Metal Film, 150 kΩ ±2%, 1/4 W
	A3R7		104889	RL07S154G	14674	RESISTOR, Metal Film, 150 kΩ ±2%, 1/4 W
	A3R8		104885	RL07S104G	14674	RESISTOR, Metal Film, 100 kΩ ±2%, 1/4 W
	A3R9		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A3R10		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A3R11		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A3R12		104843	RL07S182G	14674	RESISTOR, Metal Film, 1800 Ω ±2%, 1/4 W
	A3R13		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A3R14		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A3R15		104809	RL07S680G	14674	RESISTOR, Metal Film, 68 Ω ± 2%, 1/4 W
	A3R16		104747	C3-27-5	14674	RESISTOR, Metal Film, 27 Ω ±5%, 1/8 W
			105619	BHS-5 TO-5	71002	PAD, Transistor
			936022		01220	BOARD, Printed Circuit

Table 7-7. Triple Marker Generator Board Assembly A4 Parts List

FIG. NO / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION
8-7	A4		950004		01220	BOARD ASSY – TRIPLE MARKER GENERATOR Consisting of:
	A4C1		100253	DM15-100J	72136	CAPACITOR, Mica, 10 pF ±5%, 500 V
	A4C2		100253	DM15-100J	72136	CAPACITOR, Mica, 10 pF ±5%, 500 V
	A4C3		104146	192P2229R8	56289	CAPACITOR, Mylar, .0022 µF ±10%, 80 V
	A4C4		100253	DM15-100J	72136	CAPACITOR, Mica, 10 pF ±5%, 500 V
	A4C5		100253	DM15-100J	72136	CAPACITOR, Mica, 10 pF ±5%, 500 V
	A4C6		104146	192P2229R8	56289	CAPACITOR, Mylar, .0022 µF ±10%, 80 V
	A4C7		100253	DM15-100J	72136	CAPACITOR, Mica, 10 pF ±5%, 500 V
	A4C8		100253	DM15-100J	72136	CAPACITOR, Mica, 10 pF ±5%, 500 V
	A4C9		104146	192P2229R8	56289	CAPACITOR, Mylar, .0022 µF ±10%, 80 V
	A4CR1		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A4CR2		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A4CR3		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A4CR4		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A4CR5		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A4CR6		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A4CR7		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A4CR8		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A4CR9		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A4Q1		105659	2N4046	22229	TRANSISTOR, Dual NPN Silicon, TO-5
	A4Q2		105673	2N5087	04713	TRANSISTOR, PNP Silicon, TO-92
	A4Q3		105673	2N5087	04713	TRANSISTOR, PNP Silicon, TO-92
	A4Q4		105659	2N4046	22229	TRANSISTOR, Dual NPN Silicon, TO-5
	A4Q5		105673	2N5087	04713	TRANSISTOR, PNP Silicon, TO-92
	A4Q9		105673	2N5087	04713	TRANSISTOR, PNP Silicon, TO-92
	A4R1		105365	BA6-50K	91827	RESISTOR, Wirewound, 50 kΩ ±0.1%, 1/4 W
	A4R2		105364	BA6-25K	91827	RESISTOR, Wirewound, 25 kΩ ±0.1%, 1/4 W
	A4R3		104869	RL07S223G	14674	RESISTOR, Metal Film, 22 kΩ ±2%, 1/4 W
	A4R4		104869	RL07S223G	14674	RESISTOR, Metal Film, 22 kΩ ±2%, 1/4 W
	A4R5		104885	RL07S104G	14674	RESISTOR, Metal Film, 100 kΩ ±2%, 1/4 W
	A4R6		104866	RL07S163G	14674	RESISTOR, Metal Film, 16 kΩ ±2%, 1/4 W
	A4R7		104837	RL07S102G	14674	RESISTOR, Metal Film, 1000 Ω ±2%, 1/4 W
	A4R8		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A4R9		105365	BA6-50K	91827	RESISTOR, Wirewound, 50 kΩ ±0.1%, 1/4 W
	A4R10		105364	BA6-25K	91827	RESISTOR, Wirewound, 25 kΩ ±0.1%, 1/4 W
	A4R11		104869	RL07S223G	14674	RESISTOR, Metal Film, 22 kΩ ±2%, 1/4 W
	A4R12		104869	RL07S223G	14674	RESISTOR, Metal Film, 22 kΩ ±2%, 1/4 W
	A4R13		104885	RL07S104G	14674	RESISTOR, Metal Film, 100 kΩ ±2%, 1/4 W
	A4R14		104866	RL07S163G	14674	RESISTOR, Metal Film, 16 kΩ ±2%, 1/4 W
	A4R15		104837	RL07S102G	14674	RESISTOR, Metal Film, 1000 Ω ±2%, 1/4 W
	A4R16		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A4R17		105365	BA6-50K	91827	RESISTOR, Wirewound, 50 kΩ ±0.1%, 1/4 W
	A4R18		105364	BA6-25K	91827	RESISTOR, Wirewound, 25 kΩ ±0.1%, 1/4 W
	A4R19		104869	RL07S223G	14674	RESISTOR, Metal Film, 22 kΩ ±2%, 1/4 W
	A4R20		104869	RL07S223G	14674	RESISTOR, Metal Film, 22 kΩ ±2%, 1/4 W
	A4R21		104885	RL07S104G	14674	RESISTOR, Metal Film, 100 kΩ ±2%, 1/4 W
	A4R22		104866	RL07S163G	14674	RESISTOR, Metal Film, 16 kΩ ±2%, 1/4 W
	A4R23		104839	RL07S122G	14674	RESISTOR, Metal Film, 1200 Ω ±2%, 1/4 W
	A4R24		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
			936009		01220	BOARD, Printed Circuit

Table 7-8. Dual Precision Regulator Board Assembly A5 Parts List

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION
8-8	A5		950215		01220	BOARD ASSY — DUAL PRECISION REGULATOR Consisting of:
	A5C1		102545	DM15-270J	72136	CAPACITOR, Mica, 27 pF ±5%, 500 V
	A5C2		104149	192P1049R8	56289	CAPACITOR, Mylar, 0.1 μF ±10%, 80 V
	A5C3		104149	192P1049R8	56289	CAPACITOR, Mylar, 0.1 μF ±10%, 80 V
	A5C4		104121	TE-1152	56289	CAPACITOR, Electrolytic, 50 μF, 50 V
	A5C5		100068	DM15ED220J	72136	CAPACITOR, Mica, 22 pF ±5%, 500 V
	A5C6		104149	192P1049R8	56289	CAPACITOR, Mylar, 0.1 μF ±10%, 80 V
	A5C7		104149	192P1049R8	56289	CAPACITOR, Mylar, 0.1 μF ±10%, 80 V
	A5C8		104121	TE-1152	56289	CAPACITOR, Electrolytic, 50 μF, 50 V
	A5C9		104121	TE-1152	56289	CAPACITOR, Electrolytic, 50 μF, 50 V
	A5C10		104121	TE-1152	56289	CAPACITOR, Electrolytic, 50 μF, 50 V
	A5CR1		100386	1N827	71590	DIODE, Reference, 6.2 V ±.001%/°C
	A5CR2					Not used
	A5CR3					Not used
	A5CR4		105563	1N5232	04713	DIODE, Zener, 5.6 V ±10%, 1/2 W
	A5CR5		105563	1N5232	04713	DIODE, Zener, 5.6 V ±10%, 1/2 W
	A5Q1		105652	2N2102	18714	TRANSISTOR, NPN Silicon, TO-5
	A5Q2		025745	LM201AH	27014	INTEGRATED CIRCUIT, Operational Amplifier, TO-5
	A5Q3		105652	2N2012	18714	TRANSISTOR, NPN Silicon, TO-5
	A5Q4		025745	LM201AH	27014	INTEGRATED CIRCUIT, Operational Amplifier, TO-5
	A5Q5		105654	2N3391	03494	TRANSISTOR, NPN Silicon, R-67
	A5Q6		105654	2N3391	03494	TRANSISTOR, NPN Silicon, R-67
	A5R1		104837	RL07S102G	14674	RESISTOR, Metal Film, 1000 Ω ±2%, 1/4 W
	A5R2		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A5R3		104868	RL07S203G	14674	RESISTOR, Metal Film, 20 kΩ ±2%, 1/4 W
	A5R4		104843	RL07S182G	14674	RESISTOR, Metal Film, 1800 Ω ±2%, 1/4 W
	A5R5		104838	RL07S112G	14674	RESISTOR, Metal Film, 1100 Ω ±2%, 1/4 W
	A5R6	T				RESISTOR, Value Selected at Test
	A5R7		105386	BA6-3.9K	91827	RESISTOR, Wirewound, 3900 Ω ±1%, 1/4 W
	A5R8	T				RESISTOR, Value Selected at Test
	A5R9		105378	BA6-1.73K	91827	RESISTOR, Wirewound, 1730 Ω ±1%, 1/4 W
	A5R10		104837	RL07S102G	14674	RESISTOR, Metal Film, 1000 Ω ±2%, 1/4 W
	A5R11		104869	RL07S223G	14674	RESISTOR, Metal Film, 22 kΩ ±2%, 1/4 W
	A5R12	T	104835	RL07S821G	14674	RESISTOR, Metal Film, 820 Ω ±2%, 1/4 W
	A5R13		105362	BA6-2.5K	91827	RESISTOR, Wirewound, 2500 Ω ±0.1%, 1/4 W
	A5R14		105388	BA6-5K	91827	RESISTOR, Wirewound, 5000 Ω ±1%, 1/4 W
	A5R15		105388	BA6-5K	91827	RESISTOR, Wirewound, 5000 Ω ±1%, 1/4 W
	A5R16	T				RESISTOR, Value Selected at Test
	A5R17		105389	BA6-10K	91827	RESISTOR, Wirewound, 10 kΩ ±1%, 1/4 W
	A5R18	T				RESISTOR, Value Selected at Test
			100766	341-.093	79963	HEAT DISSIPATOR, TO-5
			105619	BHS-5 TO-5	71002	PAD, Transistor
			936161		01220	BOARD, Printed Circuit

Table 7-9. Single Precision Regulator Board Assembly A6 Parts List

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION
8-9	A6		950214		01220	BOARD ASSY – SINGLE PRECISION REGULATOR Consisting of:
	A6C1		100253	DM15-100J	72136	CAPACITOR, Mica, 10 pF ±5%, 500 V
	A6C2		104149	192P1049R8	56289	CAPACITOR, Mylar, 0.1 μF ±10%, 80 V
	A6C3		104149	192P1049R8	56289	CAPACITOR, Mylar, 0.1 μF ±10%, 80 V
	A6C4		104121	TE-1152	56289	CAPACITOR, Electrolytic, 50 μF, 50 V
	A6C5		104121	TE-1152	56289	CAPACITOR, Electrolytic, 50 μF, 50 V
	A6CR1		100443	1N4829	03508	DIODE, Signal, 20 PIV (1.87 V Fwd)
	A6CR2					Not used
	A6CR3		105583	1N4240	04713	DIODE, Zener, 10 V ±10%, 1/2 W
	A6Q1		105652	2N2102	18714	TRANSISTOR, NPN Silicon, TO-5
	A6Q2		105652	2N2102	18714	TRANSISTOR, NPN Silicon, TO-5
	A6Q3		925745	LM301AH	27014	INTEGRATED CIRCUIT, Operational Amplifier, TO-5
	A6Q4		105654	2N3391	03494	TRANSISTOR, NPN Silicon, R-67
	A6R1		104863	RL07S123G	14674	RESISTOR, Metal Film, 12 kΩ ±2%, 1/4 W
	A6R2		104817	RL07S151G	14674	RESISTOR, Metal Film, 150 Ω ±2%, 1/4 W
	A6R3		104847	RL07S272G	14674	RESISTOR, Metal Film, 2700 Ω ±2%, 1/4 W
	A6R4	T	104821	RL07S561G	14674	RESISTOR, Metal Film, 560 Ω ±2%, 1/4 W
	A6R5		103589	BA6-10K	91827	RESISTOR, Wirewound, 10 kΩ ±1%, 1/4 W
	A6R6		103588	BA6-5K	91827	RESISTOR, Wirewound, 5000 Ω ±1%, 1/4 W
	A6R7		104849	RL07S332G	14674	RESISTOR, Metal Film, 3300 Ω ±2%, 1/4 W
	A6R8		104873	RL07S333G	14674	RESISTOR, Metal Film, 33 kΩ ±2%, 1/4 W
			100766	341-093	79963	HEAT DISSIPATOR, TO-5
			105619	BHS-5 TO-5	71002	PAD, Transistor
			936160		01220	BOARD, Printed Circuit

Table 7-10. Power Supply Board Assembly A7 Parts List

FIG. NO / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION
8-10	A7		950218		01220	BOARD ASSY – POWER SUPPLY Consisting of:
	A7C1		104132	FAHEX150371698V	14655	CAPACITOR, Electrolytic, 240 μF, 300 V
	A7C2		104125	91MG0HB33	99392	CAPACITOR, Electrolytic, 3000 μF, 60 V
	A7C3		104123	91C60HB33	99392	CAPACITOR, Electrolytic, 3500 μF, 50 V
	A7CR1		100427	1N4006	04713	DIODE, Silicon, 800 PIV, 1 A
	A7CR2		105531	1N4005	12954	DIODE, Silicon, 500 PIV, 1 A
	A7CR3		105531	1N4005	12954	DIODE, Silicon, 1 A
	A7CR4		105531	1N4005	12954	DIODE, Silicon, 1 A
	A7CR5		105531	1N4005	12954	DIODE, Silicon, 1 A
	A7CR6		105531	1N4005	12954	DIODE, Silicon, 1 A
	A7CR7		105531	1N4005	12954	DIODE, Silicon, 1 A
	A7CR8		105531	1N4005	12954	DIODE, Silicon, 1 A
	A7CR9		105531	1N4005	12954	DIODE, Silicon, 500 PIV, 1 A
	A7R1		104998	EB6831	01121	RESISTOR, Carbon, 68 kΩ ±10%, 1/2 W
	A7R2		104904	RL20S222G	14674	RESISTOR, Metal Film, 2200 Ω ±2%, 1/2 W
	A7R3		105012	GB1041	01121	RESISTOR, Carbon, 100 kΩ ±10%, 1 W
	A7R4		104873	RL07S333G	14674	RESISTOR, Metal Film, 33 kΩ ±2%, 1/4 W
	A7R5		104873	RL07S333G	14674	RESISTOR, Metal Film, 33 kΩ ±2%, 1/4 W
	A7T1	F	105753	4-2545	17474	TRANSFORMER, per Spec. Control B962044
			936156		01220	BOARD, Printed Circuit

Table 7-11. Dual Operational Amplifier Board Assembly A8 Parts List

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION
8-11	A8		950216		01220	BOARD ASSY — DUAL OPERATIONAL AMPLIFIER Consisting of:
	A8C1		100068	DM15ED220J	72136	CAPACITOR, Mica, 22 pF ±5%, 500 V
	A8C2		104147	192P1039R8	56289	CAPACITOR, Mylar, .01 µF ±10%, 80 V
	A8C3		102545	DM15-270J	72136	CAPACITOR, Mica, 27 pF ±5%, 500 V
	A8C4		100068	DM15ED220J	72136	CAPACITOR, Mica, 22 pF ±5%, 500 V
	A8C5		100219	DM10-151J	72136	CAPACITOR, Mica, 150 pF ±5%, 500 V
	A8C6		104138	DM15-681J	72126	CAPACITOR, Mica, 680 pF ±5%, 300 V
	A8C7		102545	DM15-270J	72136	CAPACITOR, Mica, 27 pF ±5%, 500 V
	A8C8		102545	DM15-270J	72136	CAPACITOR, Mica, 27 pF ±5%, 500 V
	A8CR1		105563	1N5232	04713	DIODE, Zener, 5.6 V ±10%, 1/2 W
	A8CR2		105563	1N5232	04713	DIODE, Zener, 5.6 V ±10%, 1/2 W
	A8Q1		025745	LM301AH	27014	INTEGRATED CIRCUIT, Operational Amplifier, TO-5
	A8Q2		105652	2N2102	18714	TRANSISTOR, NPN Silicon, TO-5
	A8Q3		025745	LM301AH	27014	INTEGRATED CIRCUIT, Operational Amplifier, TO-5
	A8Q4		025745	LM301AH	27014	INTEGRATED CIRCUIT, Operational Amplifier, TO-5
	A8R1		105364	BA6-25K	91827	RESISTOR, Wirewound, 25 kΩ ±0.1%, 1/4 W
	A8R2		105364	BA6-25K	91827	RESISTOR, Wirewound, 25 kΩ ±0.1%, 1/4 W
	A8R3		105392	BA6-8.2K	91827	RESISTOR, Wirewound, 8200 Ω ±1%, 1/4 W
	A8R4	T	104813	RL07S101G	14674	RESISTOR, Metal Film, 100 Ω ±2%, 1/4 W
	A8R5		105370	BA6-100K	91827	RESISTOR, Wirewound, 100 kΩ ±1/2%, 1/4 W
	A8R6		104863	RL07S123G	14674	RESISTOR, Metal Film, 12 kΩ ±2%, 1/4 W
	A8R7		105364	BA6-25K	91827	RESISTOR, Wirewound, 25 kΩ ±0.1%, 1/4 W
	A8R8		104863	RL07S123G	14674	RESISTOR, Metal Film, 12 kΩ ±2%, 1/4 W
	A8R9		104837	RL07S102G	14674	RESISTOR, Metal Film, 1000 Ω ±2%, 1/4 W
	A8R10		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A8R11		104809	RL07S680G	14674	RESISTOR, Metal Film, 68 Ω ±2%, 1/4 W
	A8R12		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A8R13		104926		01121	RESISTOR, Carbon, 2000 Ω ±5%, 2 W
	A8R14		104885	RL07S104G	14674	RESISTOR, Metal Film, 100 kΩ ±2%, 1/4 W
	A8R15		104870	RL07S243G	14674	RESISTOR, Metal Film, 24 kΩ ±2%, 1/4 W
	A8R16		104868	RL07S203G	14674	RESISTOR, Metal Film, 20 kΩ ±2%, 1/4 W
	A8R17		104870	RL07S243G	14674	RESISTOR, Metal Film, 24 kΩ ±2%, 1/4 W
	A8R18		104870	RL07S243G	14674	RESISTOR, Metal Film, 24 kΩ ±2%, 1/4 W
	A8R19	T				RESISTOR, Value Selected at Test
	A8R20		104870	RL07S243G	14674	RESISTOR, Metal Film, 24 kΩ ±2%, 1/4 W
	A8R21	T				RESISTOR, Value Selected at Test
	A8R22		104813	RL07S101G	14674	RESISTOR, Metal Film, 100 Ω ±2%, 1/4 W
	A8R23	T				RESISTOR, Value Selected at Test
	A8R24	T				RESISTOR, Value Selected at Test
	A8R25		104863	RL07S123G	14674	RESISTOR, Metal Film, 12 kΩ ±2%, 1/4 W
			105619	BHS-5 TO-5	71002	PAD, Transistor
			936157		01220	BOARD, Printed Circuit

Table 7-12. Sweep-Second Board Assembly A9 Parts List

FIG. NO / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION
8-12	A9		950168		01220	BOARD ASSY – SWEEP-SECOND Consisting of
	A9C1		104147	192P1039R8	56289	CAPACITOR, Mylar, .01 µF ±10%, 80 V
	A9CR1		105586	1N5245	04713	DIODE, Zener, 15 V ±10%, 1/2 W
	A9CR2		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A9CR3		105586	1N5245	04713	DIODE, Zener, 15 V ±10%, 1/2 W
	A9CR4		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A9CR5		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A9R1		104695	RN60D1874F	14674	RESISTOR, Metal Film, 1.87 MΩ ±1%, 1/4 W
	A9R2		104694	RN60D1624F	14674	RESISTOR, Metal Film, 1.62 MΩ ±1%, 1/4 W
	A9R3		101683	CB5655	01121	RESISTOR, Carbon, 5.6 MΩ ±5%, 1/4 W
	A9R4	T				RESISTOR, Value Selected at Test
	A9R5		104698	RN60D4643F	14674	RESISTOR, Metal Film, 464 kΩ ±1%, 1/4 W
	A9R6	T				RESISTOR, Value Selected at Test
	A9R7	T	104885	RL07S104G	14674	RESISTOR, Metal Film, 100 kΩ ±2%, 1/4 W
	A9R8		104845	RL07S222G	14674	RESISTOR, Metal Film, 2200 Ω ±2%, 1/4 W
	A9R9	T	104828	RL07S431G	14674	RESISTOR, Metal Film, 430 Ω ±2%, 1/4 W
	A9R10		104834	RL07S751G	14674	RESISTOR, Metal Film, 750 Ω ±2%, 1/4 W
	A9R11		105183	BA6-1K	91827	RESISTOR, Wirewound, 1000 Ω ±1%, 1/4 W
	A9R12		104806	RL07S510G	14674	RESISTOR, Metal Film, 51 Ω ±2%, 1/4 W
			936072		01220	BOARD, Printed Circuit

Table 7-13. Overcurrent Limit Board Assembly A10 Parts List

FIG. NO / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION
8-13	A10		950217		01220	BOARD ASSY – OVERCURRENT LIMIT Consisting of
	A10R1		105405	RS1A-0.5	09969	RESISTOR, Wirewound, 0.5 Ω ±5%, 1 W
	A10R2		105405	RS1A-0.5	09969	RESISTOR, Wirewound, 0.5 Ω ±5%, 1 W
	A10R3		105405	RS1A-0.5	09969	RESISTOR, Wirewound, 0.5 Ω ±5%, 1 W
	A10R4		104837	RL07S102G	14674	RESISTOR, Metal Film, 1000 Ω ±2%, 1/4 W
	A10R5		104824	RL07S301G	14674	RESISTOR, Metal Film, 300 Ω ±2%, 1/4 W
	A10R6		104813	RL07S101G	14674	RESISTOR, Metal Film, 100 Ω ±2%, 1/4 W
			936163		01220	BOARD, Printed Circuit

Table 7-14. Extender Board Assembly A11 Parts List

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION
8-14	A11		950007		01220	BOARD ASSY — EXTENDER Consisting of:
	A11J1		104199	250 10 30 170	07233	CONNECTOR, Receptacle, 10 pin
			936027		01220	BOARD, Printed Circuit

Table 7-15. Dial Assembly A12 Parts List

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION
7-1						
12	A12		950014		01220	DIAL ASSEMBLY Containing:
	R11		104870	RL07S243G	14674	RESISTOR, Metal Film, 24 kΩ ±2%, 1/4 W
	R12		105525	3200-1844-1	11534	RESISTOR, Variable, 1 kΩ, 3 turn (F2-STOP)
	R14		105522	3200-1845	11534	RESISTOR, Variable, 2 kΩ, 3 turn (MARKER 1)
	R15		104878	RL07S513G	14674	RESISTOR, Metal Film, 51 kΩ ±2%, 1/4 W
	R16		105522	3200-1845	11534	RESISTOR, Variable, 2 kΩ, 3 turn (MARKER 3)
	R17		104878	RL07S513G	14674	RESISTOR, Metal Film, 51 kΩ ±2%, 1/4 W
	R24		104870	RL07S243G	14674	RESISTOR, Metal Film, 24 kΩ ±2%, 1/4 W
	R25		105525	3200-1844-1	11534	RESISTOR, Variable, 1 kΩ, 3 turn (F1-START)
	R26		105522	3200-1845	11534	RESISTOR, Variable, 2 kΩ, 3 turn (MARKER 2—Fc)
	R27		104878	RL07S513G	14674	RESISTOR, Metal Film, 51 kΩ ±2%, 1/4 W

Table 7-16. Blanking Inverter Board Assembly A13 (Option M1) Parts List

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION
8-15	A13	M1	950025		01220	BOARD ASSY – BLANKING INVERTER (Option M1) Consisting of:
	A13CR1		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A13Q1		105673	2N5087	04713	TRANSISTOR, PNP Silicon, TO-92
	A13R1		104865	RL07S153G	14674	RESISTOR, Metal Film, 15 kΩ ±2%, 1/4 W
	A13R2		104867	RL07S183G	14674	RESISTOR, Metal Film, 18 kΩ ±2%, 1/4 W
	A13R3		105006	RCR32G102KS	01221	RESISTOR, Carbon, 1000 Ω ±10%, 1 W
			936099		01220	BOARD, Printed Circuit

Table 7-17. Positive Reference Output Board Assembly A14 (Option M3) Parts List

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION
8-16	A14	M3	950269		01220	BOARD ASSY – POSITIVE REFERENCE OUTPUT (Option M3) Consisting of:
	A14C1		104147	192P1039R8	56289	CAPACITOR, Mylar, .01 μF ±10%, 80 V
	A14C2		100068	DM15ED220J	72136	CAPACITOR, Mica, 22 pF ±5%, 500 V
	A14C3		100219	DM10-151J	72136	CAPACITOR, Mica, 150 pF ±5%, 500 V
	A14C4		100137	192P10292	56289	CAPACITOR, Mylar, .001 μF ±10%, 200 V
	A14C5		104147	192P1039R8	56289	CAPACITOR, Mylar, .01 μF ±10%, 80 V
	A14C6		104135	196D266X0020FB	56289	CAPACITOR, Tantalum, 22 μF, 25 V
	A14CR1		100421	1N4734A	04713	DIODE, Zener, 5.6 V ±10%, 1 W
	A14CR2		100421	1N4734A	04713	DIODE, Zener, 5.6 V ±10%, 1 W
	A14CR3		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A14CR4		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A14CR5		105539	1N3716	08806	DIODE, Tunnel, 4.7 mA, 50 pF
	A14Q1		105659	2N4045	22229	TRANSISTOR, Dual NPN Silicon, TO-5
	A14Q2		105673	2N5087	04713	TRANSISTOR, PNP Silicon, TO-92
	A14Q3		105673	2N5087	04713	TRANSISTOR, PNP Silicon, TO-92
	A14Q4		105652	2N2012	18714	TRANSISTOR, NPN Silicon, TO-5
	A14R1		105393	BA6-3.6	91827	RESISTOR, Wirewound, 3600 Ω ±1%, 1/4 W
	A14R2		105021	RCR42G333B	01121	RESISTOR, Carbon, 33 kΩ ±10%, 2 W
	A14R3		104589	RL07S154G	14674	RESISTOR, Metal Film, 150 kΩ ±2%, 1/4 W
	A14R4		104889	RL07S154G	14674	RESISTOR, Metal Film, 150 kΩ ±2%, 1/4 W
	A14R5		104885	RL07S104G	14674	RESISTOR, Metal Film, 100 kΩ ±2%, 1/4 W
	A14R6		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A14R7		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A14R8		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A14R9		104725	RL07S102G	14674	RESISTOR, Metal Film, 1000 Ω ±2%, 1/4 W
	A14R10		104819	RL07S181G	14674	RESISTOR, Metal Film, 180 Ω ±2%, 1/4 W
	A14R11		104843	RL07S182G	14674	RESISTOR, Metal Film, 1800 Ω ±2%, 1/4 W
	A14R12		105393	BA6-3 6	91827	RESISTOR, Wirewound, 3600 Ω ±1%, 1/4 W
	A14R13		104847	RL07S272G	14674	RESISTOR, Metal Film, 2700 Ω ±2%, 1/4 W
			936087		01220	BOARD, Printed Circuit

SECTION VIII

PARTS LOCATION/SCHEMATIC DIAGRAMS

This section contains the following parts location drawings and schematic diagrams applicable to the Model 5000A Sweeper Mainframe:

Figure	*Title*	*Page*
8-1	Chassis Parts Terminal Connections	8-2
8-2	5000A Chassis Wiring Diagram	8-3
8-3	5000A Overall Schematic Diagram	8-7
8-4	Timing Capacitor Board Assembly A1 Parts Location/Schematic Diagram	8-9
8-5	Trigger-Sweep Board Assembly A2 Parts Location/Schematic Diagram	8-11
8-6	Single Operational Amplifier Board Assembly A3 Parts Location/Schematic Diagram	8-13
8-7	Triple Marker Generator Board Assembly A4 Parts Location/Schematic Diagram	8-15
8-8	Dual Precision Regulator Board Assembly A5 Parts Location/Schematic Diagram	8-17
8-9	Single Precision Regulator Board Assembly A6 Parts Location/Schematic Diagram	8-19
8-10	Power Supply Board Assembly A7 Parts Location/Schematic Diagram	8-21
8-11	Dual Operational Amplifier Board Assembly A8 Parts Location/Schematic Diagram	8-23
8-12	Sweep-Second Board Assembly A9 Parts Location/Schematic Diagram	8-25
8-13	Overcurrent Limit Board Assembly A10 Parts Location/Schematic Diagram	8-25
8-14	Model 5000A Options Parts Location/Schematic Diagrams	8-27

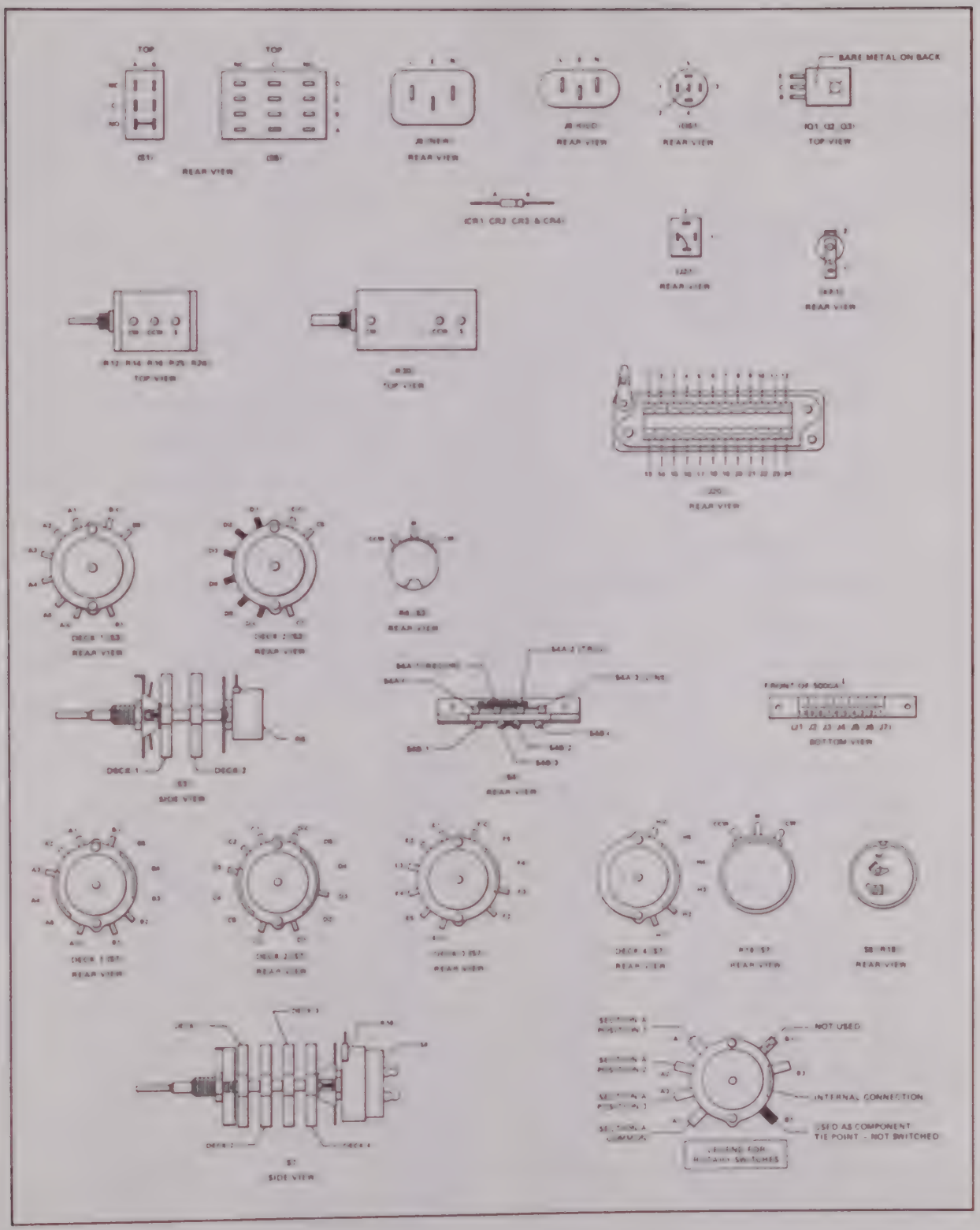
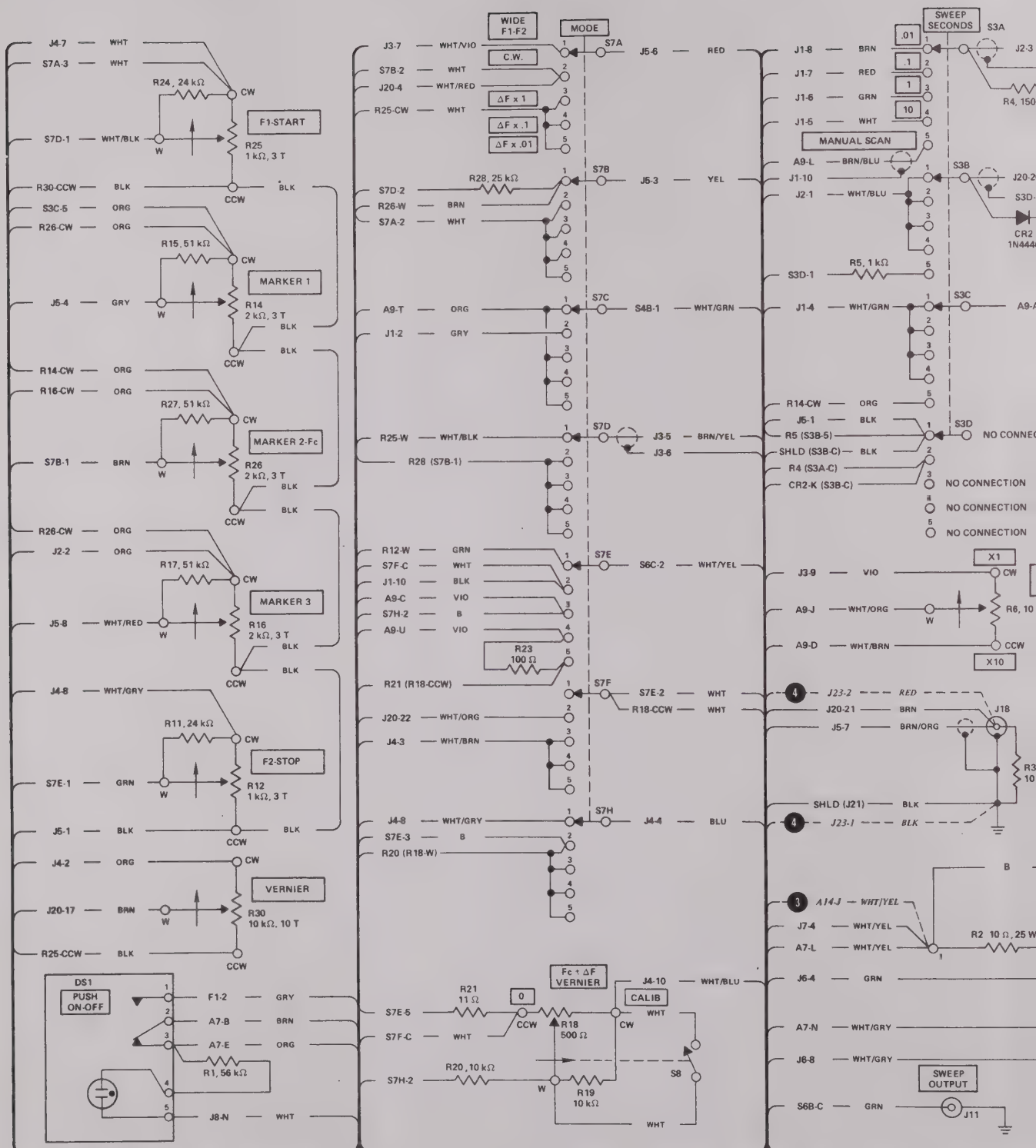


Figure 8-1. Chassis Parts Terminal Connections


J4-7 WHT
S7A-3 WHT
R24, 24 kΩ
CW
F1-START
S7D-1 WHT/BLK
W
R25
1 kΩ, 3 T
R30-CCW BLK
BLK
CCW
S3C-5 ORG
R26-CW ORG
R15, 51 kΩ
MARKER 1
J5-4 GRY
R14
2 kΩ, 3 T
R14-CW ORG
R16-CW ORG
R27, 51 kΩ
MARKER 2-Fc
S7B-1 BRN
R26
2 kΩ, 3 T
J2-2 ORG
R17, 51 kΩ
MARKER 3
J5-8 WHT/RED
R16
2 kΩ, 3 T
J4-8 WHT/GRY
R11, 24 kΩ
F2-STOP
S7E-1 GRN
R12
1 kΩ, 3 T
J5-1 BLK
J4-2 ORG
VERNIER
J20-17 BRN
R30
10 kΩ, 10 T
R25-CCW BLK
DS1
PUSH ON-OFF
F1-2 GRY
A7-B BRN
A7-E ORG
R1, 56 kΩ
J8-N WHT
WIDE F1-F2
MODE
S7A
J3-7 WHT/VIO
C.W.
S7B-2 WHT
J20-4 WHT/RED
R25-CW WHT
ΔF x 1
ΔF x .1
ΔF x .01
J5-6 RED
S7B
R28, 25 kΩ
S7D-2
R26-W BRN
S7A-2 WHT
J5-3 YEL
S7C
A9-T ORG
J1-2 GRY
S48-1 WHT/GRN
S7D
R25-W WHT/BLK
R28 (S7B-1)
J3-5 BRN/YEL
J3-6
S7E
R12-W GRN
S7F-C WHT
J1-10 BLK
A9-C VIO
S7H-2 B
A9-U VIO
R23
100 Ω
S6C-2 WHT/YEL
R21 (R18-CCW)
S7F
J20-22 WHT/ORG
J4-3 WHT/BRN
S7E-2 WHT
R18-CCW WHT
J4-8 WHT/GRY
S7E-3 B
R20 (R18-W)
S7H
J4-4 BLU
Fc ± ΔF VERNIER
R21
11 Ω
0
S7E-5
S7F-C WHT
CCW
R18
500 Ω
CW
J4-10 WHT/BLU
CALIB
WHT
R20, 10 kΩ
S7H-2
W
R19
10 kΩ
S8
WHT
SWEEP SECONDS
S3A
.01
.1
1
10
J1-8 BRN
J1-7 RED
J1-6 GRN
J1-5 WHT
MANUAL SCAN
A9-L BRN/BLU
S3B
J1-10
J2-1 WHT/BLU
CR2
1N444
S3D-1
R5, 1 kΩ
S3C
J1-4 WHT/GRN
R14-CW ORG
J5-1 BLK
S3D
R5 (S3B-5)
SHLD (S3B-C) BLK
R4 (S3A-C)
CR2-K (S3B-C)
NO CONNECTION
NO CONNECTION
NO CONNECTION
X1
X10
J3-9 VIO
A9-J WHT/ORG
A9-D WHT/BRN
R6, 10
J23-2 RED
J20-21 BRN
J5-7 BRN/ORG
J18
SHLD (J21) BLK
J23-1 BLK
A14-J WHT/YEL
J7-4 WHT/YEL
A7-L WHT/YEL
R2 10 Ω, 25 W
J6-4 GRN
A7-N WHT/GRY
J6-8 WHT/GRY
SWEEP OUTPUT
S6B-C GRN
J11

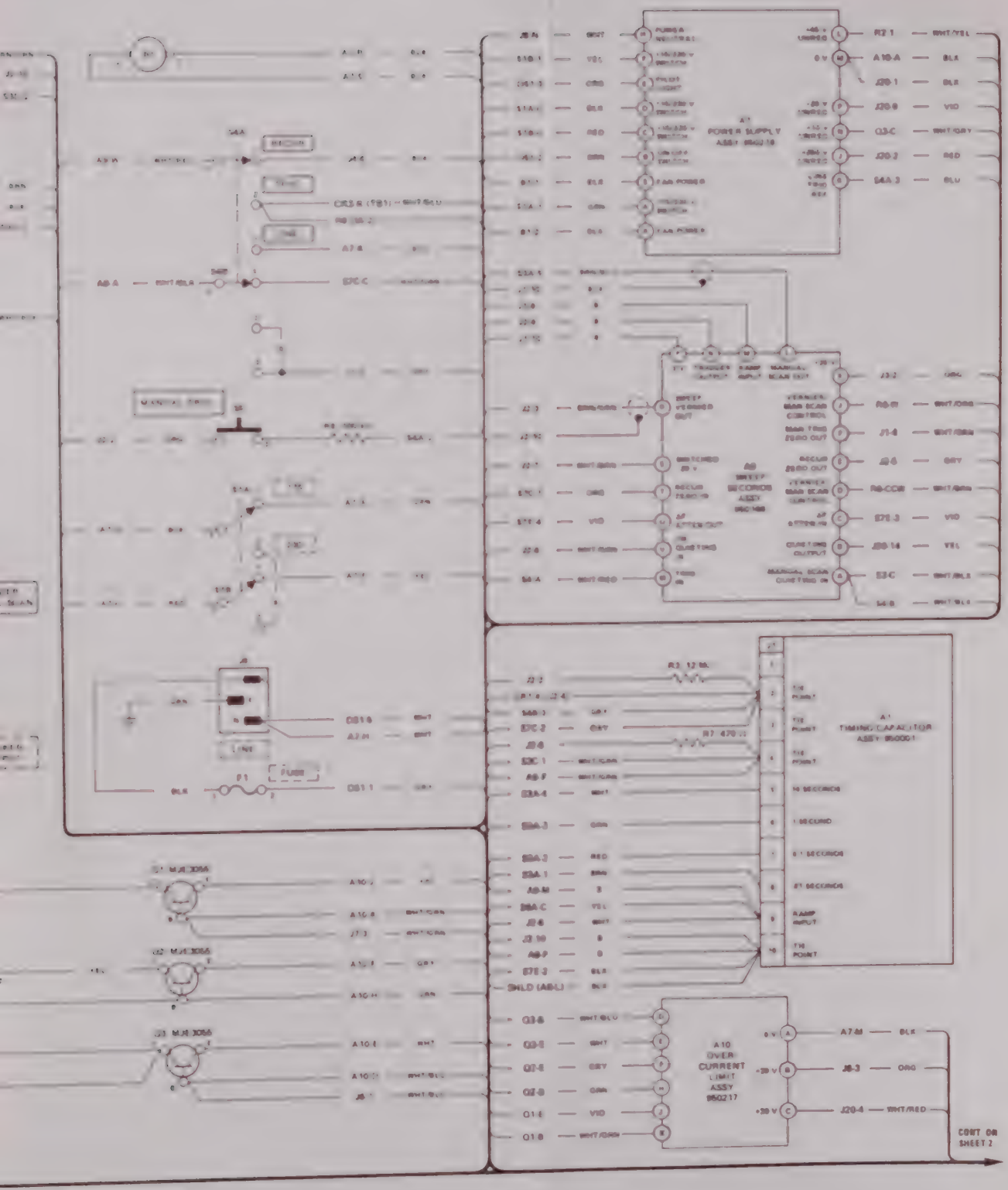
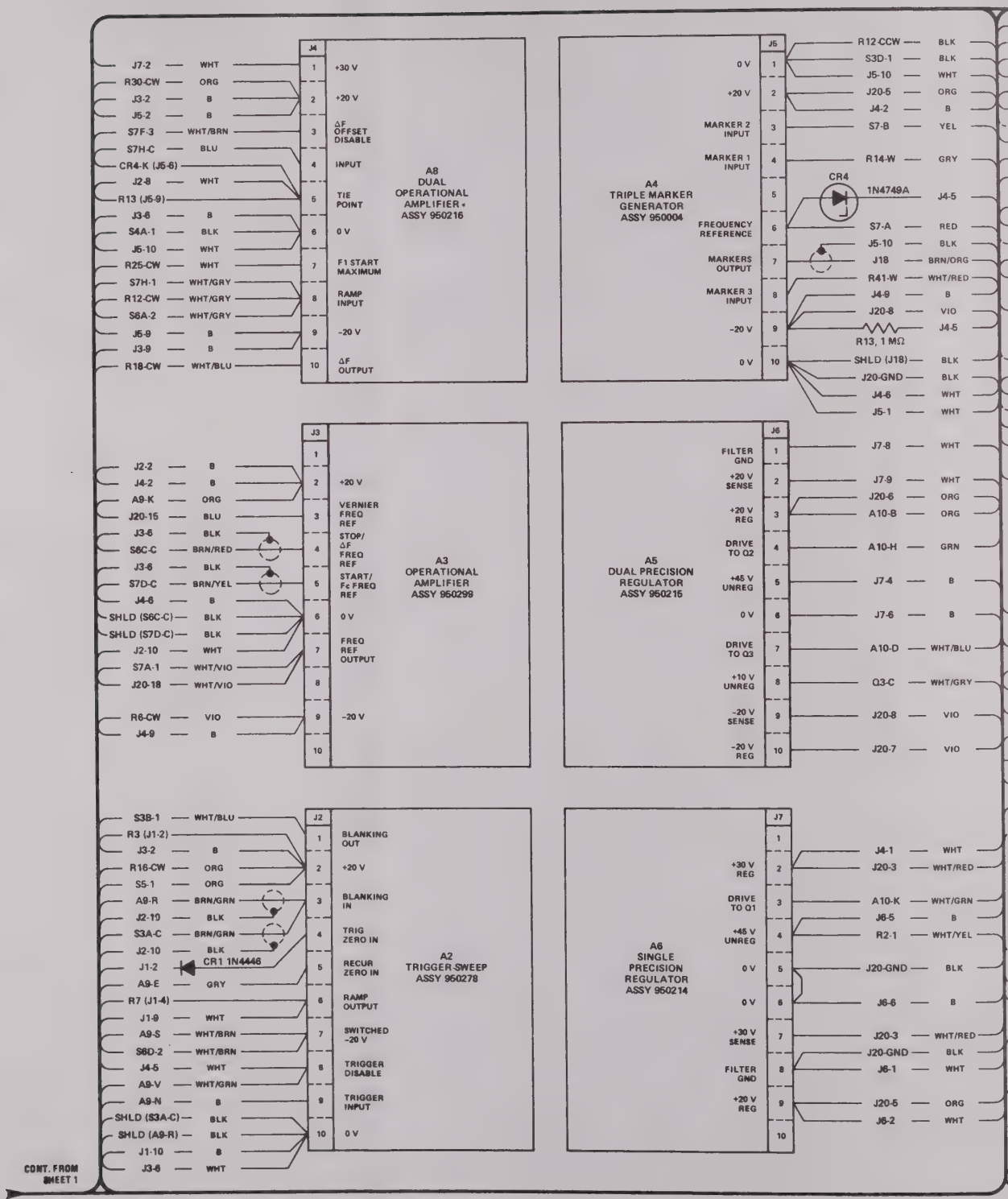


Figure 8-2. 5000A Chassis Wiring Diagram (Sheet 1 of 2)


J4
J7-2 WHT 1 +30 V
R30-CW ORG
J3-2 B 2 +20 V
J5-2 B
S7F-3 WHT/BRN 3 ΔF OFFSET DISABLE
S7H-C BLU
CR4-K (J5-6) 4 INPUT
J2-8 WHT
R13 (J5-9) 5 TIE POINT
J3-6 B
S4A-1 BLK 6 0 V
J5-10 WHT
R25-CW WHT 7 F1 START MAXIMUM
S7H-1 WHT/GRY
R12-CW WHT/GRY 8 RAMP INPUT
S6A-2 WHT/GRY
J5-9 B 9 -20 V
J3-9 B
R18-CW WHT/BLU 10 ΔF OUTPUT
A8 DUAL OPERATIONAL AMPLIFIER ASSY 950216
J5
0 V 1
+20 V 2
MARKER 2 INPUT 3
MARKER 1 INPUT 4
FREQUENCY REFERENCE 6
MARKERS OUTPUT 7
MARKER 3 INPUT 8
-20 V 9
0 V 10
A4 TRIPLE MARKER GENERATOR ASSY 950004
R12-CCW BLK
S3D-1 BLK
J5-10 WHT
J20-5 ORG
J4-2 B
S7-B YEL
R14-W GRY
CR4 1N4749A J4-5
S7-A RED
J5-10 BLK
J18 BRN/ORG
R41-W WHT/RED
J4-9 B
J20-8 VIO
R13, 1 MΩ J4-5
SHLD (J18) BLK
J20-GND BLK
J4-6 WHT
J5-1 WHT
J3
1
J2-2 B
J4-2 B 2 +20 V
A9-K ORG
J20-15 BLU 3 VERNIER FREQ REF
J3-6 BLK
S6C-C BRN/RED 4 STOP/ ΔF FREQ REF
J3-6 BLK
S7D-C BRN/YEL 5 START/ Fc FREQ REF
J4-6 B
SHLD (S6C-C) BLK 6 0 V
SHLD (S7D-C) BLK
J2-10 WHT 7 FREQ REF OUTPUT
S7A-1 WHT/VIO
J20-18 WHT/VIO 8
R6-CW VIO 9 -20 V
J4-9 B 10
A3 OPERATIONAL AMPLIFIER ASSY 950299
J6
FILTER GND 1
+20 V SENSE 2
+20 V REG 3
DRIVE TO Q2 4
+45 V UNREG 5
0 V 6
DRIVE TO Q3 7
+10 V UNREG 8
-20 V SENSE 9
-20 V REG 10
A5 DUAL PRECISION REGULATOR ASSY 950215
J7-8 WHT
J7-9 WHT
J20-6 ORG
A10-B ORG
A10-H GRN
J7-4 B
J7-6 B
A10-D WHT/BLU
Q3-C WHT/GRY
J20-8 VIO
J20-7 VIO
J2
S3B-1 WHT/BLU 1 BLANKING OUT
R3 (J1-2)
J3-2 B 2 +20 V
R16-CW ORG
S5-1 ORG
A9-R BRN/GRN 3 BLANKING IN
J2-19 BLK
S3A-C BRN/GRN 4 TRIG ZERO IN
J2-10 BLK
J1-2 CR1 1N4448 5 RECUR ZERO IN
A9-E GRY
R7 (J1-4) 6 RAMP OUTPUT
J1-9 WHT
A9-S WHT/BRN 7 SWITCHED -20 V
S6D-2 WHT/BRN
J4-5 WHT 8 TRIGGER DISABLE
A9-V WHT/GRN
A9-N B 9 TRIGGER INPUT
SHLD (S3A-C) BLK
SHLD (A9-R) BLK 10 0 V
J1-10 B
J3-6 WHT
A2 TRIGGER-SWEEP ASSY 950278
J7
1
+30 V REG 2
DRIVE TO Q1 3
+45 V UNREG 4
0 V 5
0 V 6
+30 V SENSE 7
FILTER GND 8
+20 V REG 9
10
A6 SINGLE PRECISION REGULATOR ASSY 950214
J4-1 WHT
J20-3 WHT/RED
A10-K WHT/GRN
J6-5 B
R2-1 WHT/YEL
J20-GND BLK
J6-6 B
J20-3 WHT/RED
J20-GND BLK
J6-1 WHT
J20-5 ORG
J6-2 WHT
CONT. FROM SHEET 1

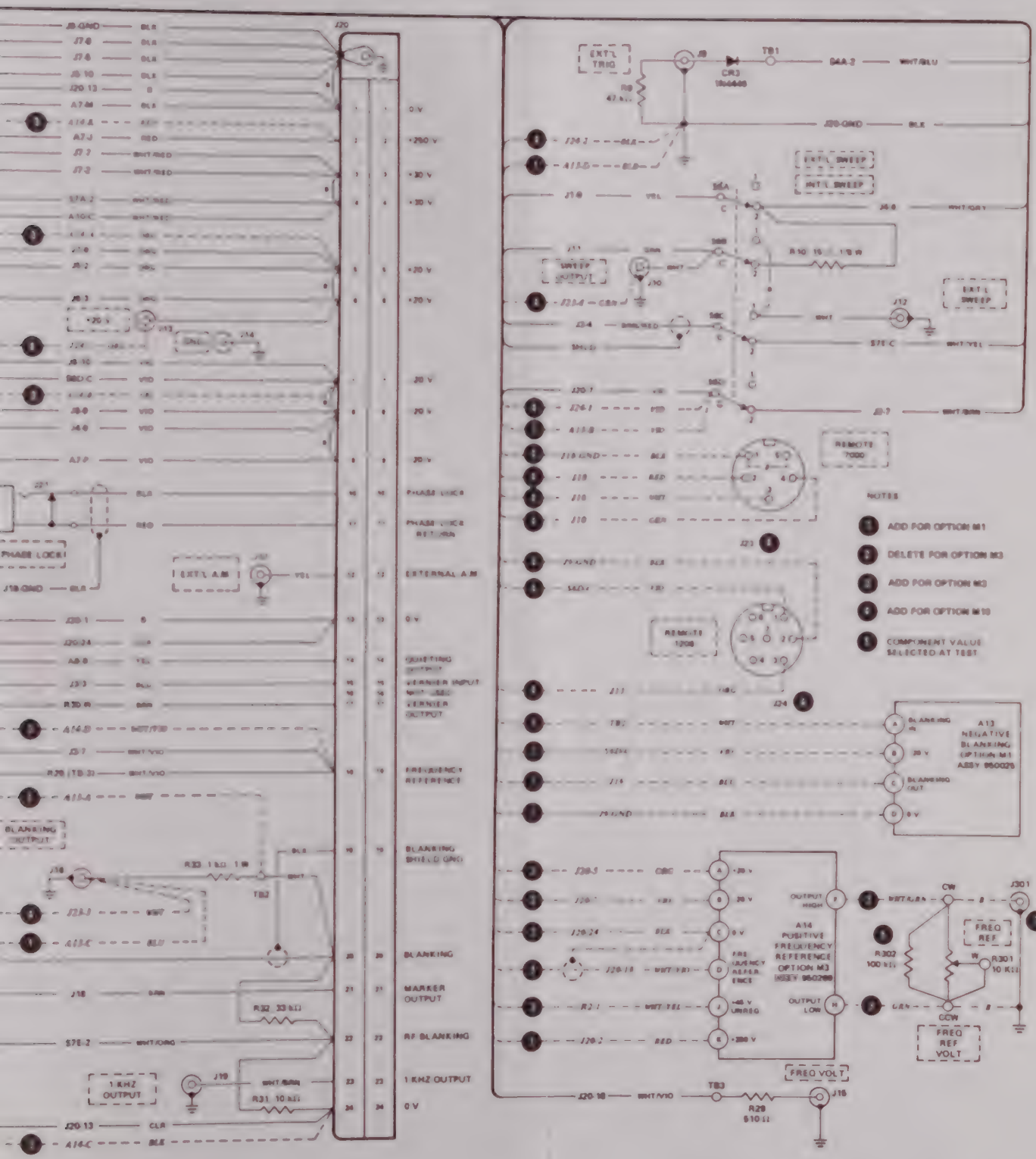
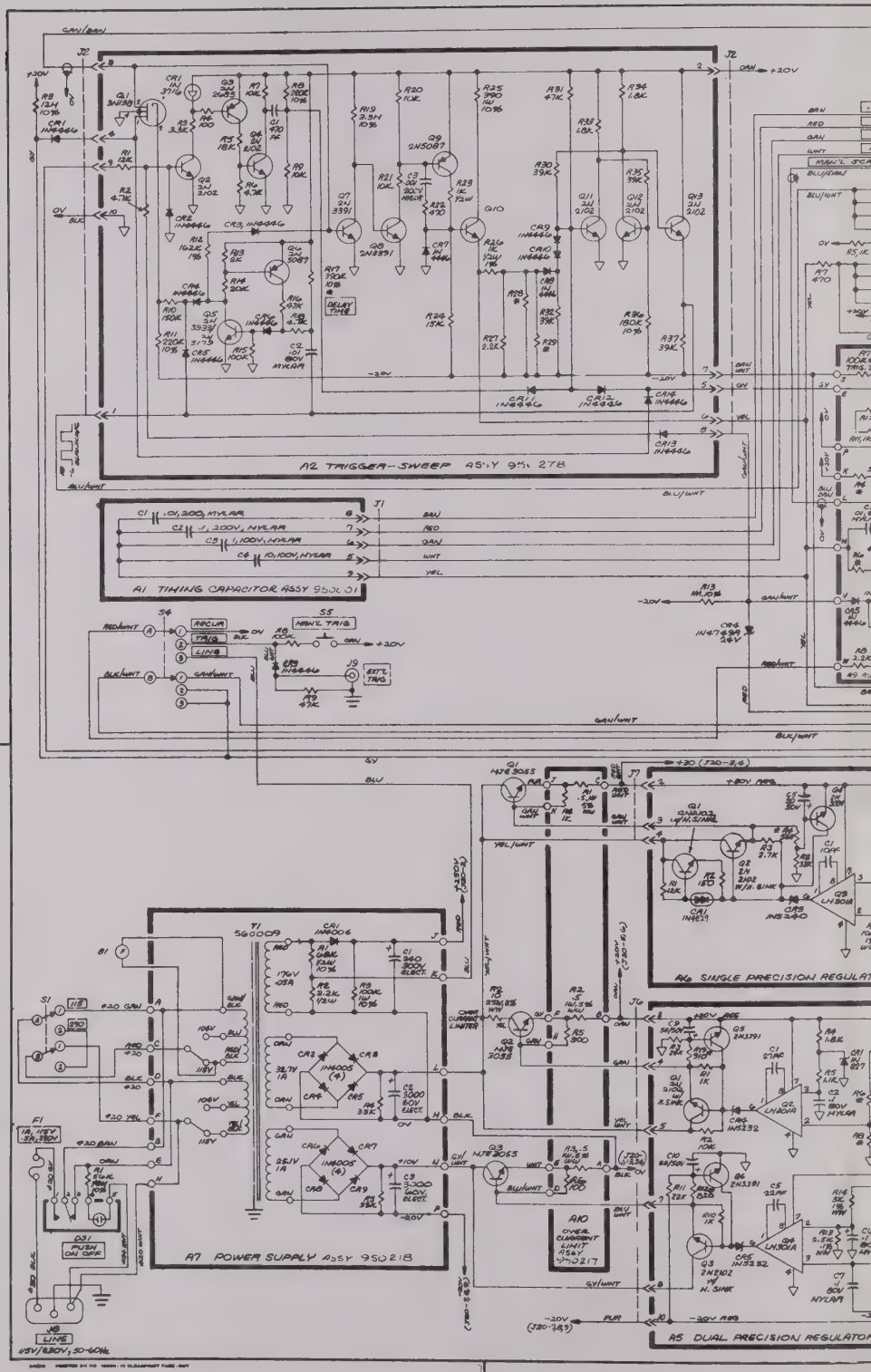


Figure 8-2. 5000A Chassis Wiring Diagram (Sheet 2 of 2)


A2 TRIGGER-SWEEP ASSY 950127B
A1 TIMING CAPACITOR ASSY 950131
A7 POWER SUPPLY ASSY 950218
A10 OVERLOAD LIMIT ASSY 950217
A6 SINGLE PRECISION REGULATOR
A5 DUAL PRECISION REGULATOR
115V/230V, 50-60Hz

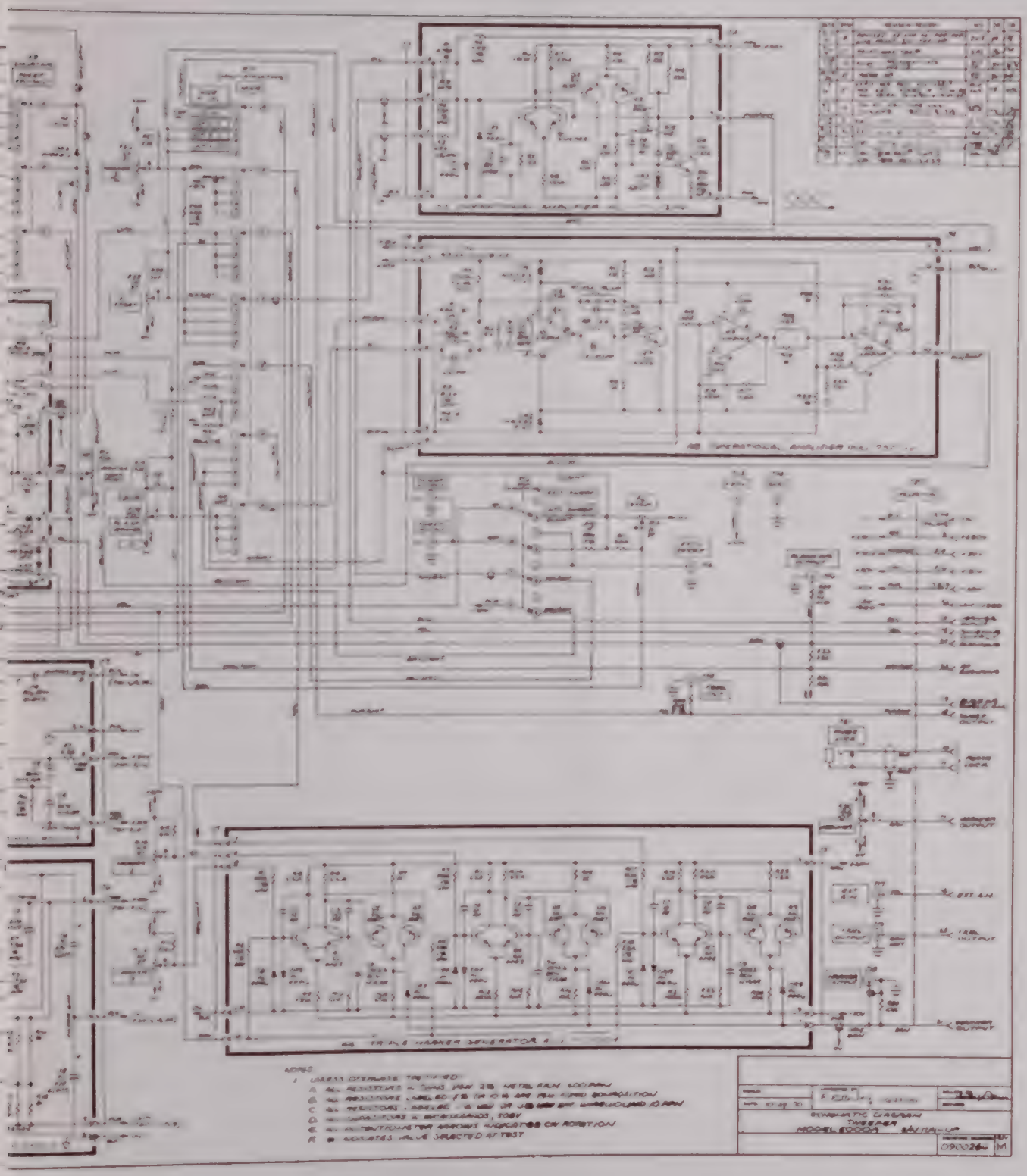
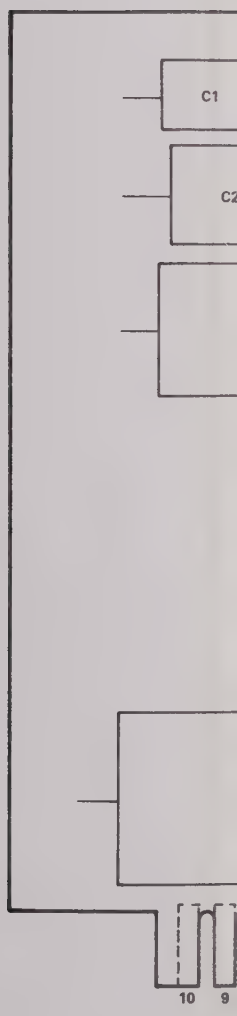


Figure 8-3. 5000A Overall Schematic Diagram


C1
C2
10
9

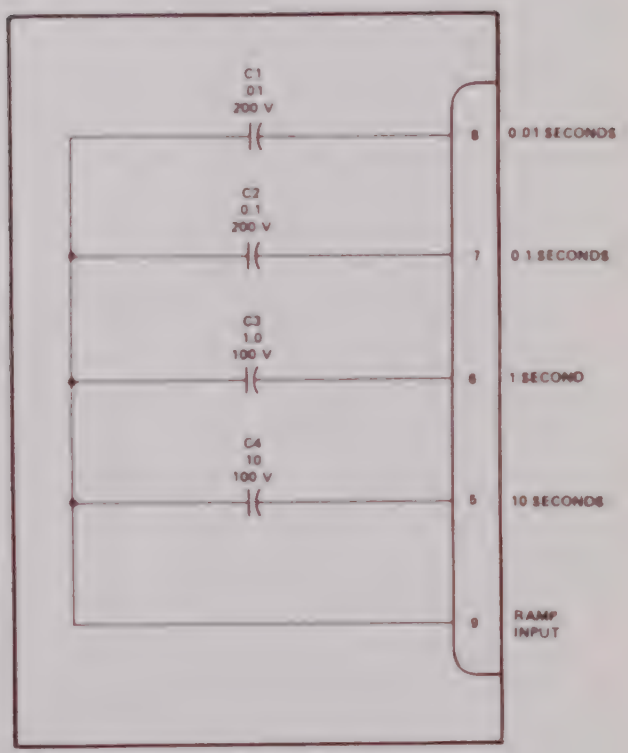
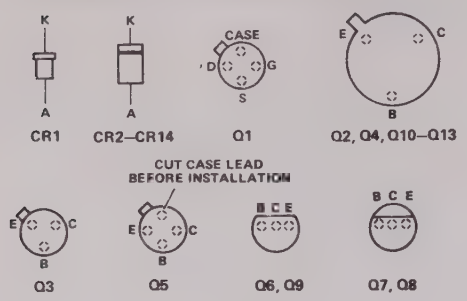
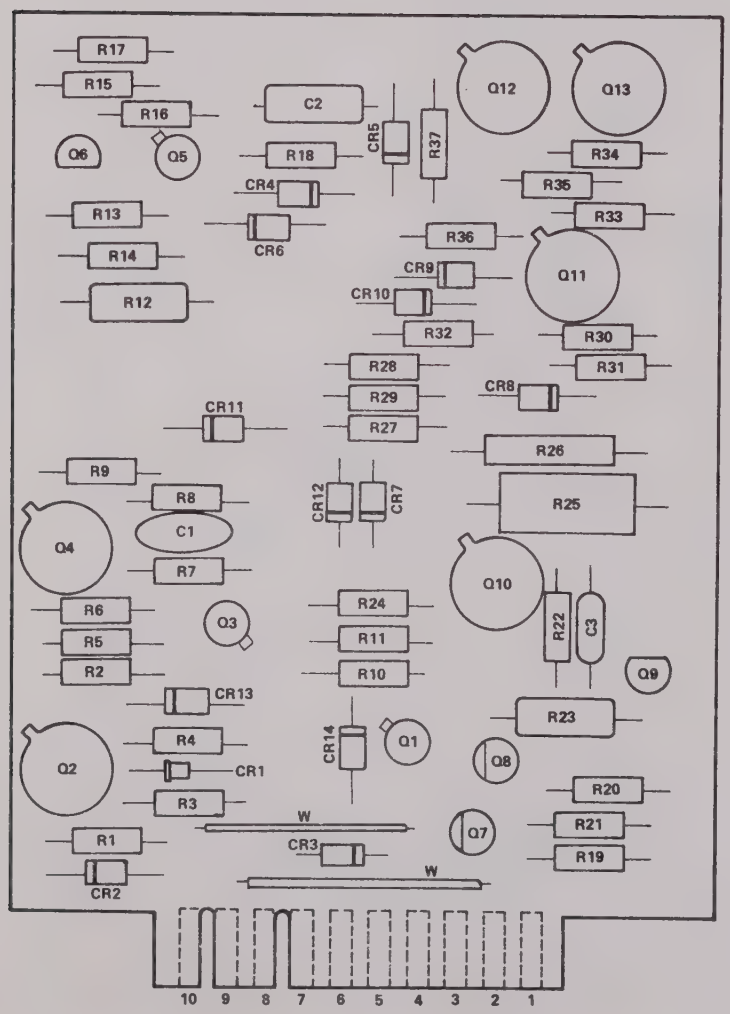
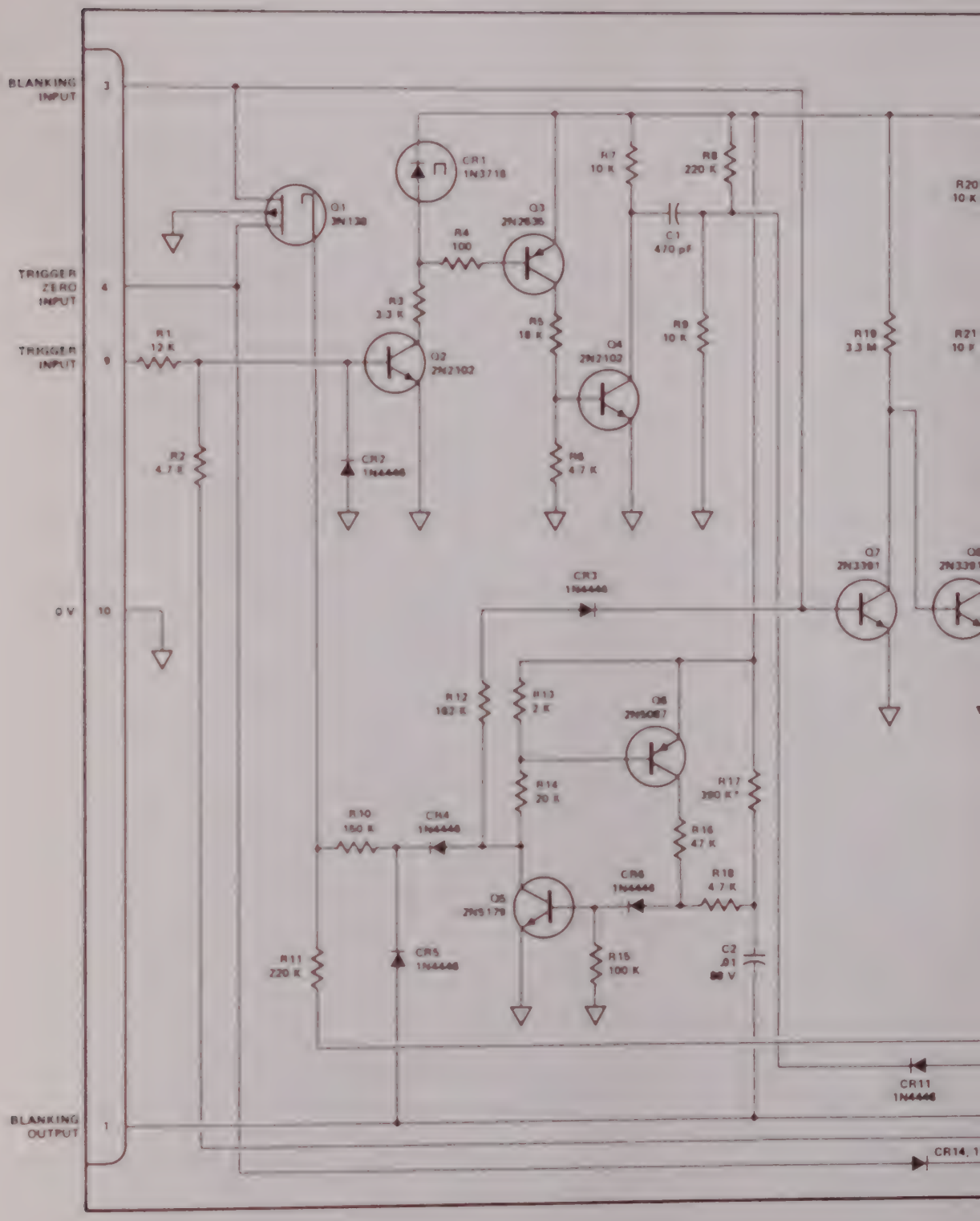


Figure 8-4. Timing Capacitor Board Assembly A1 Parts Location/Schematic Diagram

VIEWS FROM TOP OF SEMICONDUCTOR DEVICE






BLANKING INPUT
3
TRIGGER ZERO INPUT
4
TRIGGER INPUT
9
0 V
10
BLANKING OUTPUT
1
CR1 1N3718
Q1 3N138
Q3 2N2635
R4 100
C1 470 pF
R7 10 K
R8 220 K
R3 3.3 K
R5 18 K
R9 10 K
R1 12 K
Q2 2N2102
Q4 2N2102
R2 4.7 K
CR2 1N4446
R6 4.7 K
R19 3.3 M
R21 10 F
Q7 2N3391
CR3 1N4446
R12 182 K
R13 2 K
Q6 2N5087
R14 20 K
R17 390 K*
R10 150 K
CR4 1N4446
R16 47 K
CR6 1N4446
R18 4.7 K
Q5 2N5179
R11 220 K
CR5 1N4446
R15 100 K
C2 .01 50 V
CR11 1N4446
CR14, 1

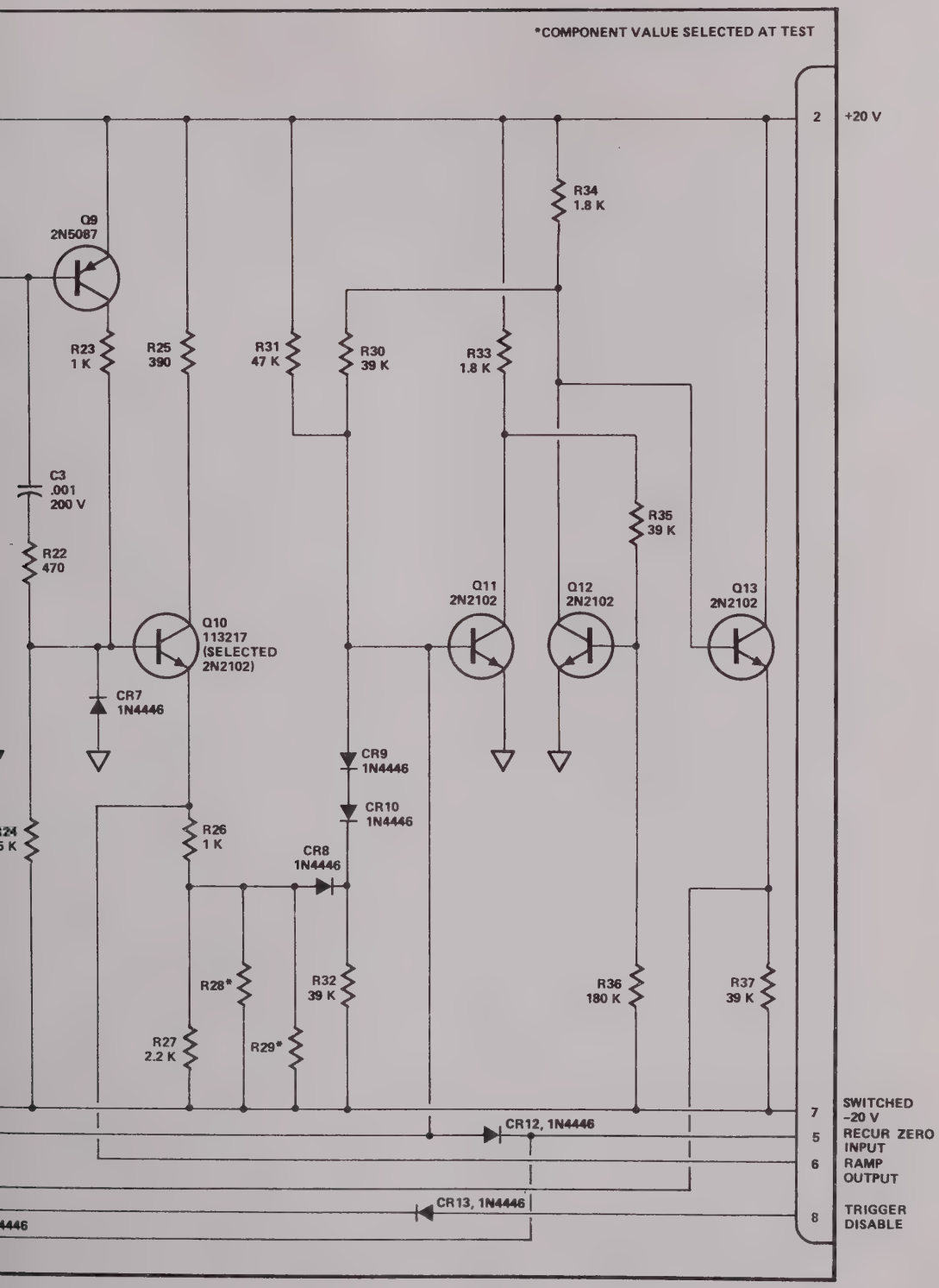
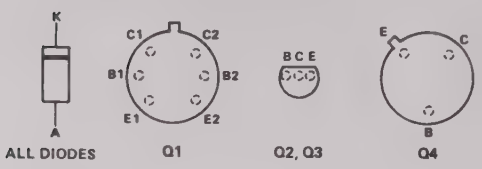
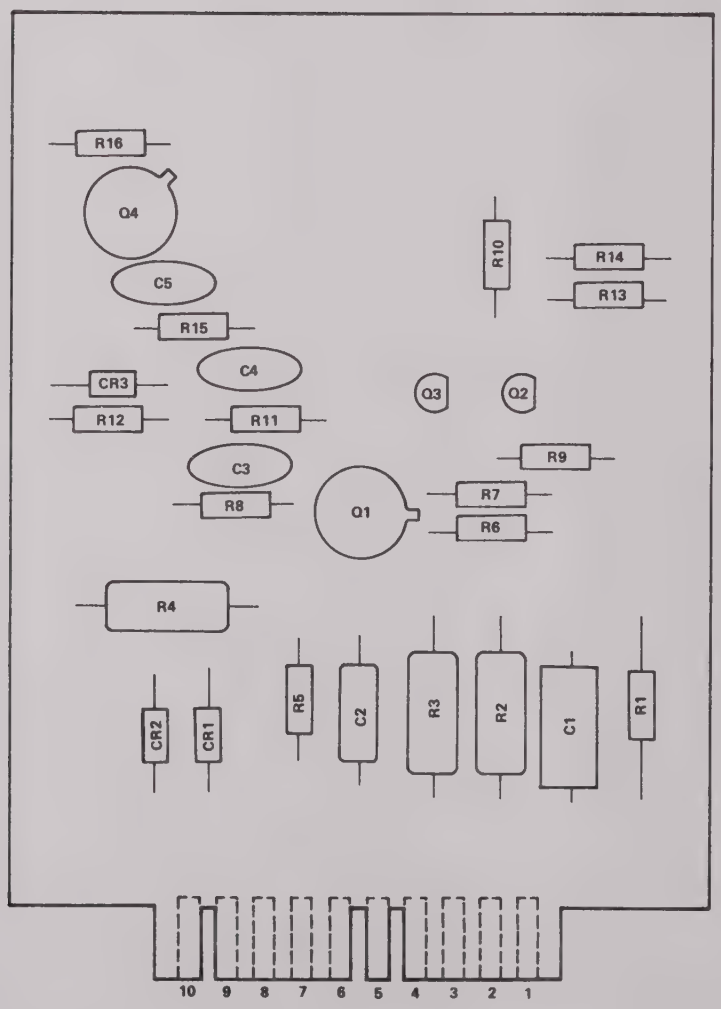
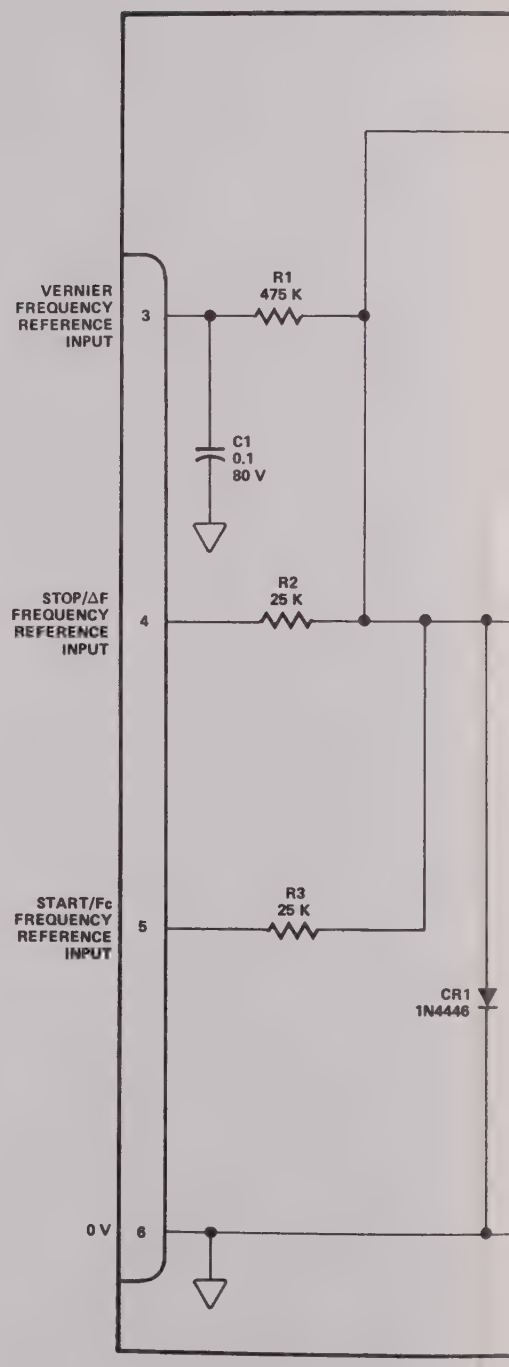


Figure 8-5. Trigger-Sweep Board Assembly A2 Parts Location/Schematic Diagram

VIEWS FROM TOP OF SEMICONDUCTOR DEVICE







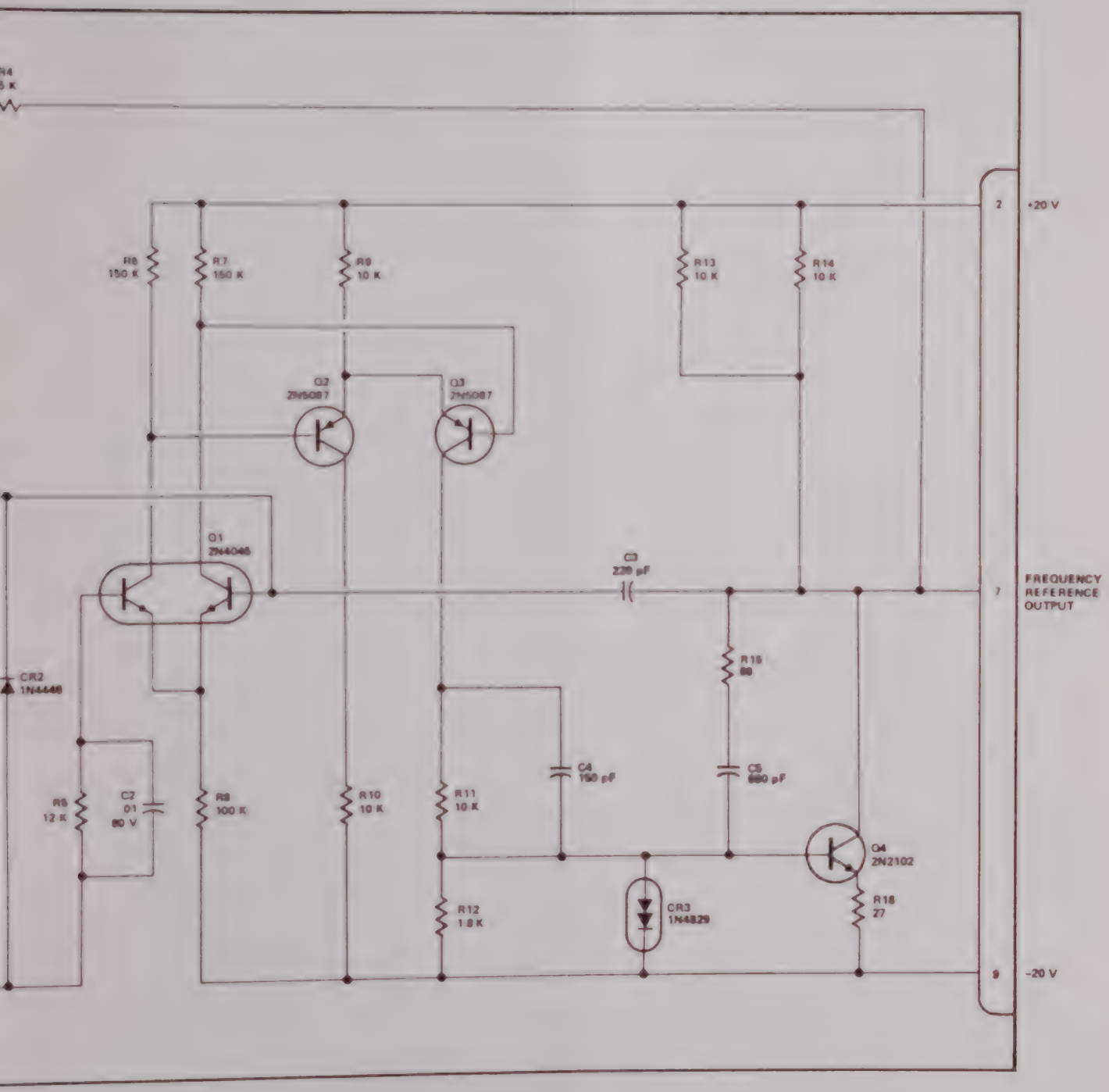
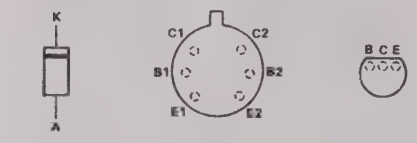
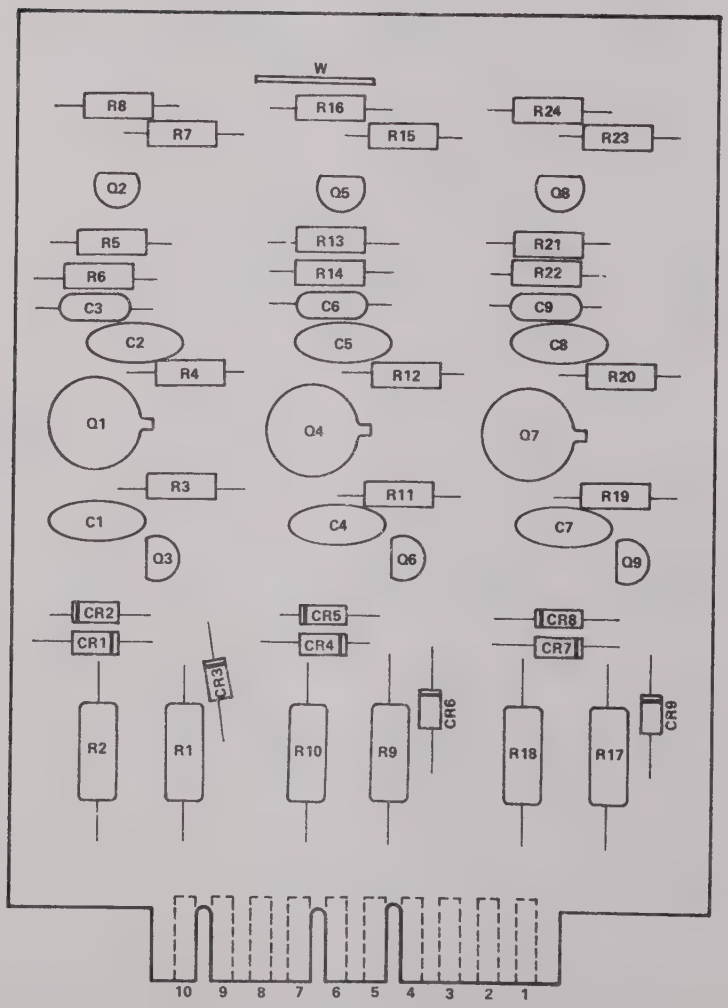


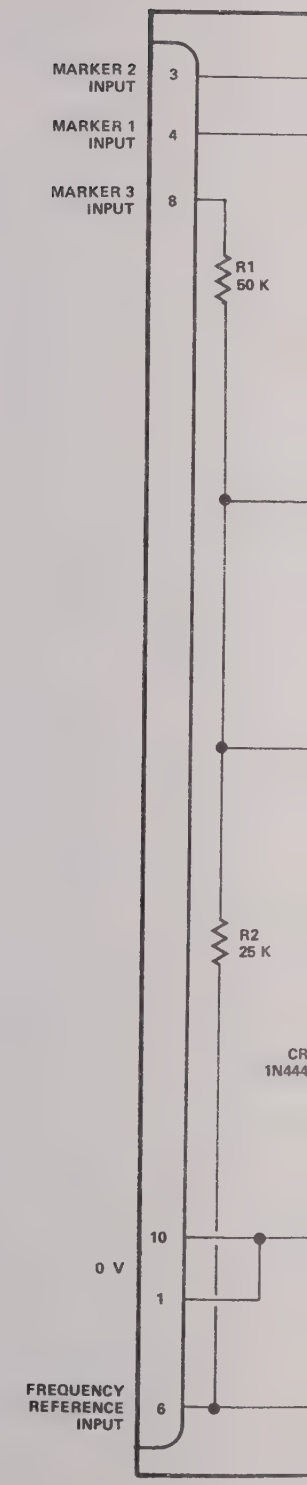
Figure 8-6. Single Operational Amplifier Board Assembly A3 Parts Location/Schematic Diagram

VIEWS FROM TOP OF SEMICONDUCTOR DEVICE



ALL DIODES Q1, Q4, Q7 Q2, Q3, Q5, Q6, Q8, Q9





R3
22 K
R4
22 K
R7
1 K
R9
50 K
R11
22 K
R12
22 K
C1
10 pF
C4
10 pF
C2
10 pF
C5
10 pF
Q1
2N4046
Q2
2N5087
Q3
2N5087
Q4
2N4046
Q5
2N5087
CR2
1N4446
R10
25 K
CR5
1N4446
R5
100 K
C3
.0022
R6
10 K
R8
10 K
CR3
1N4446
CR4
1N4446
R13
100 K
C6
.0022
R14
16 K

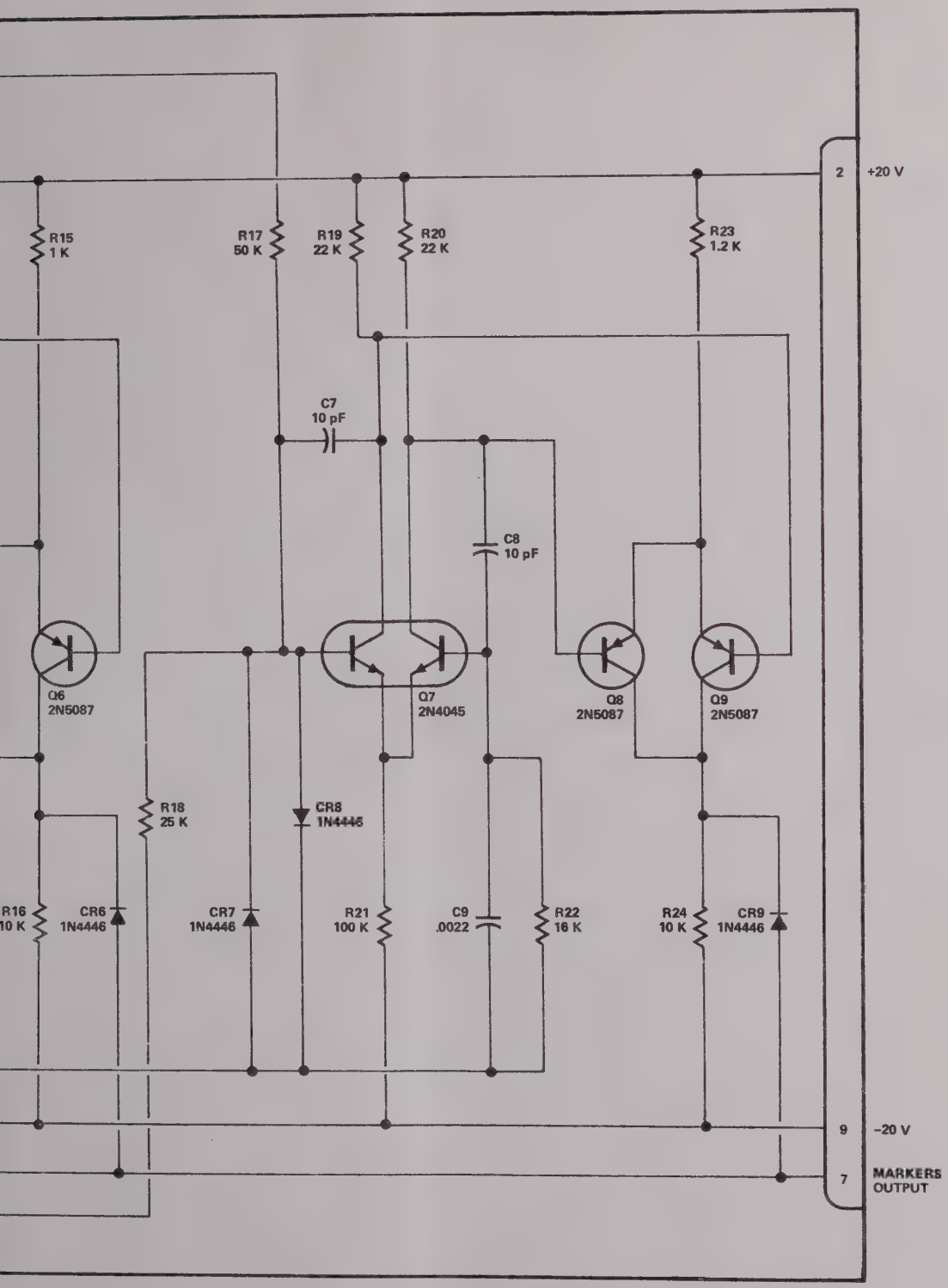
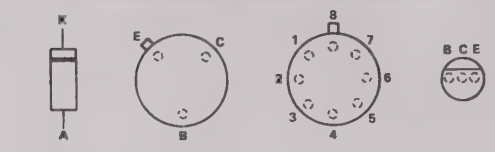
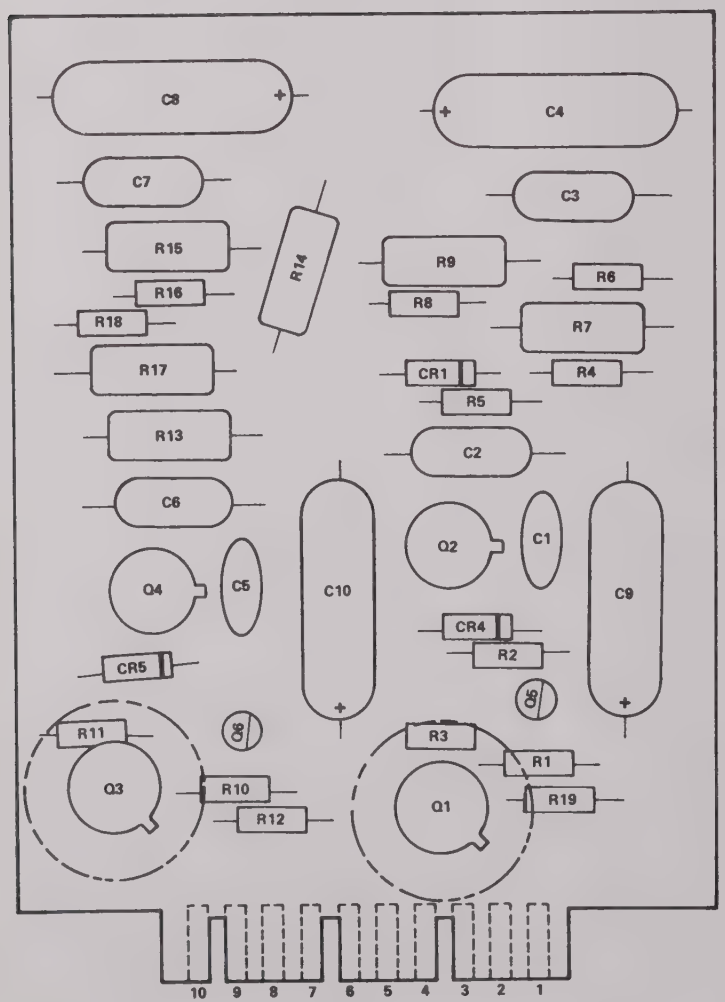


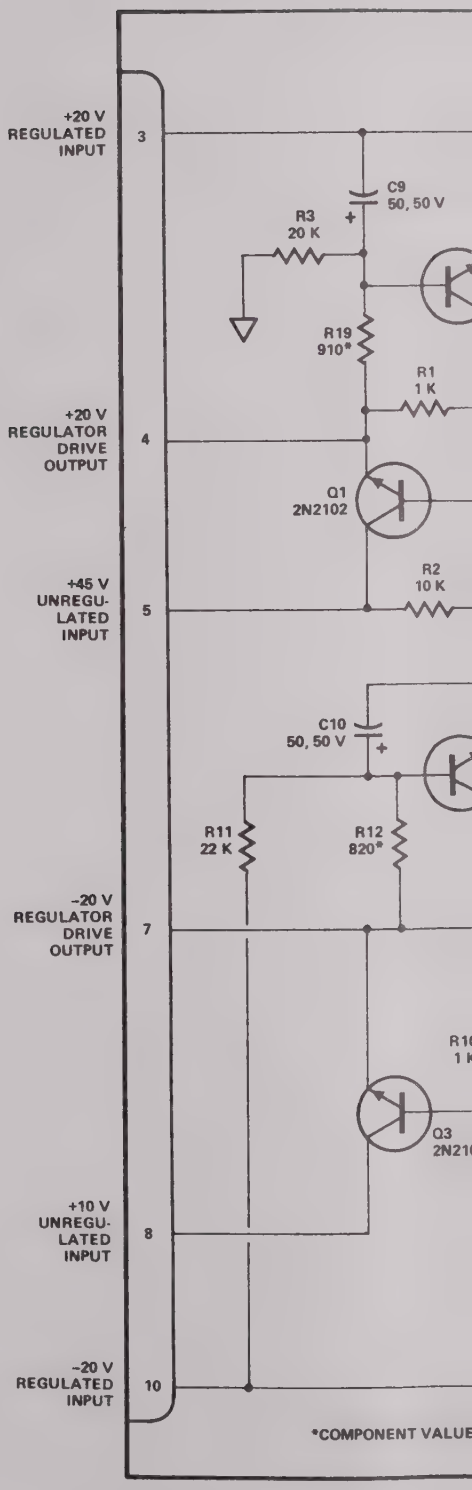
Figure 8-7. Triple Marker Generator Board Assembly A4 Parts Location/Schematic Diagram

VIEWS FROM TOP OF SEMICONDUCTOR DEVICE



ALL DIODES Q1, Q3 Q2, Q4 Q5, Q6





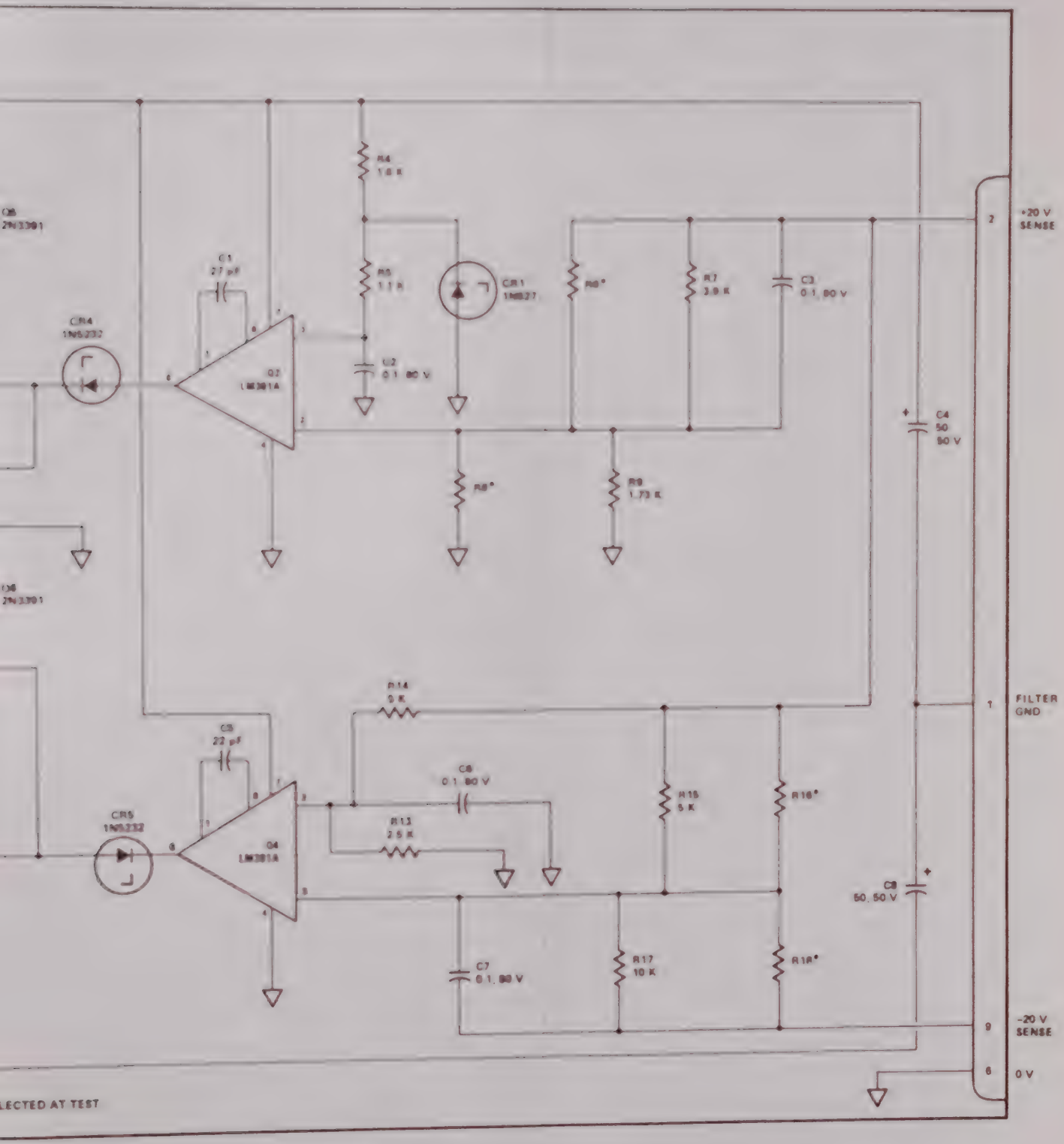
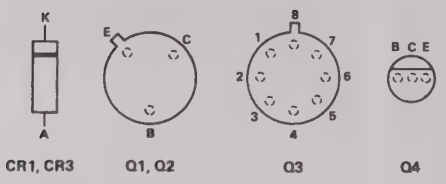
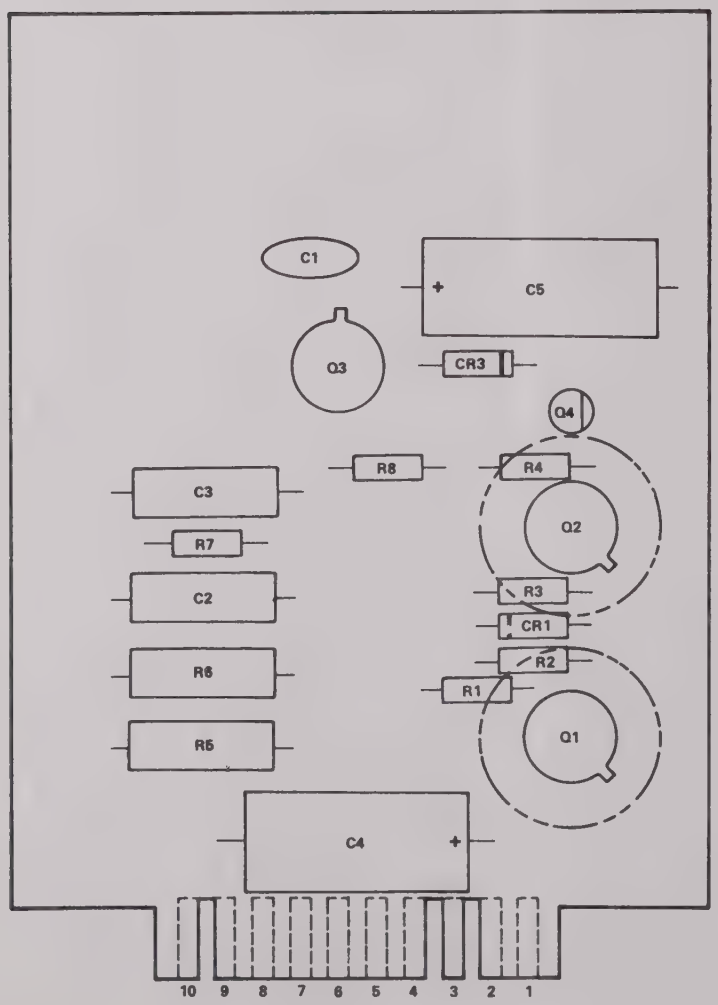
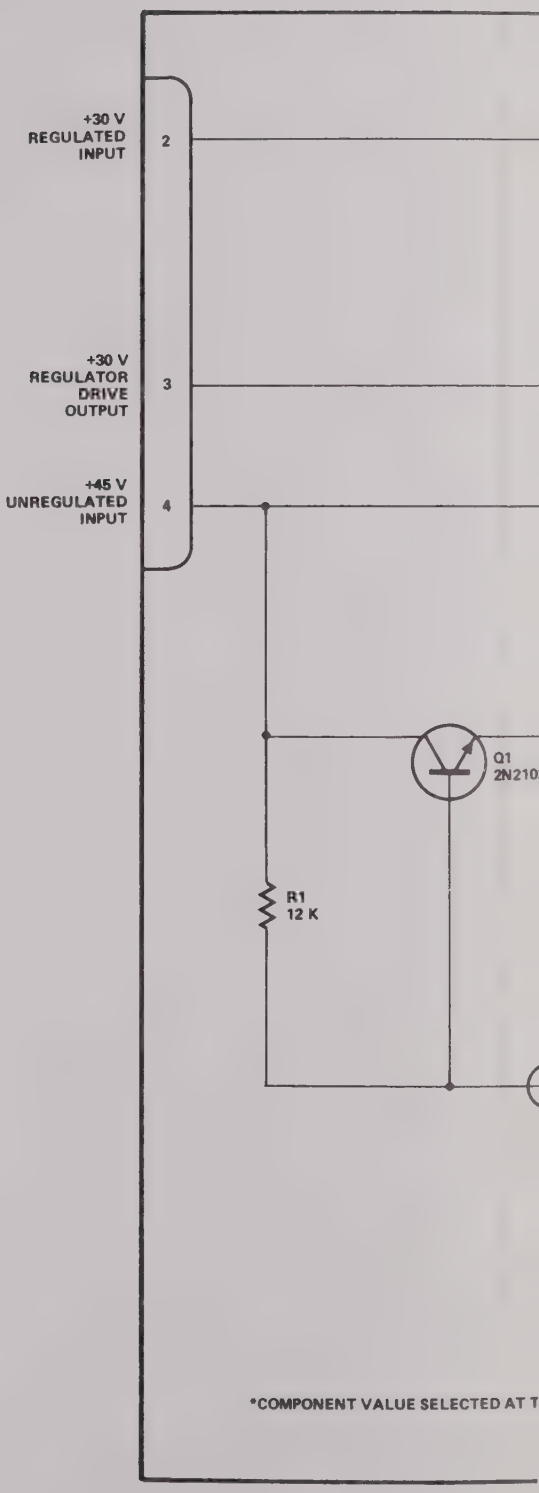


Figure 8-8. Dual Precision Regulator Board Assembly A5 Parts Location/Schematic Diagram

VIEWS FROM TOP OF SEMICONDUCTOR DEVICE







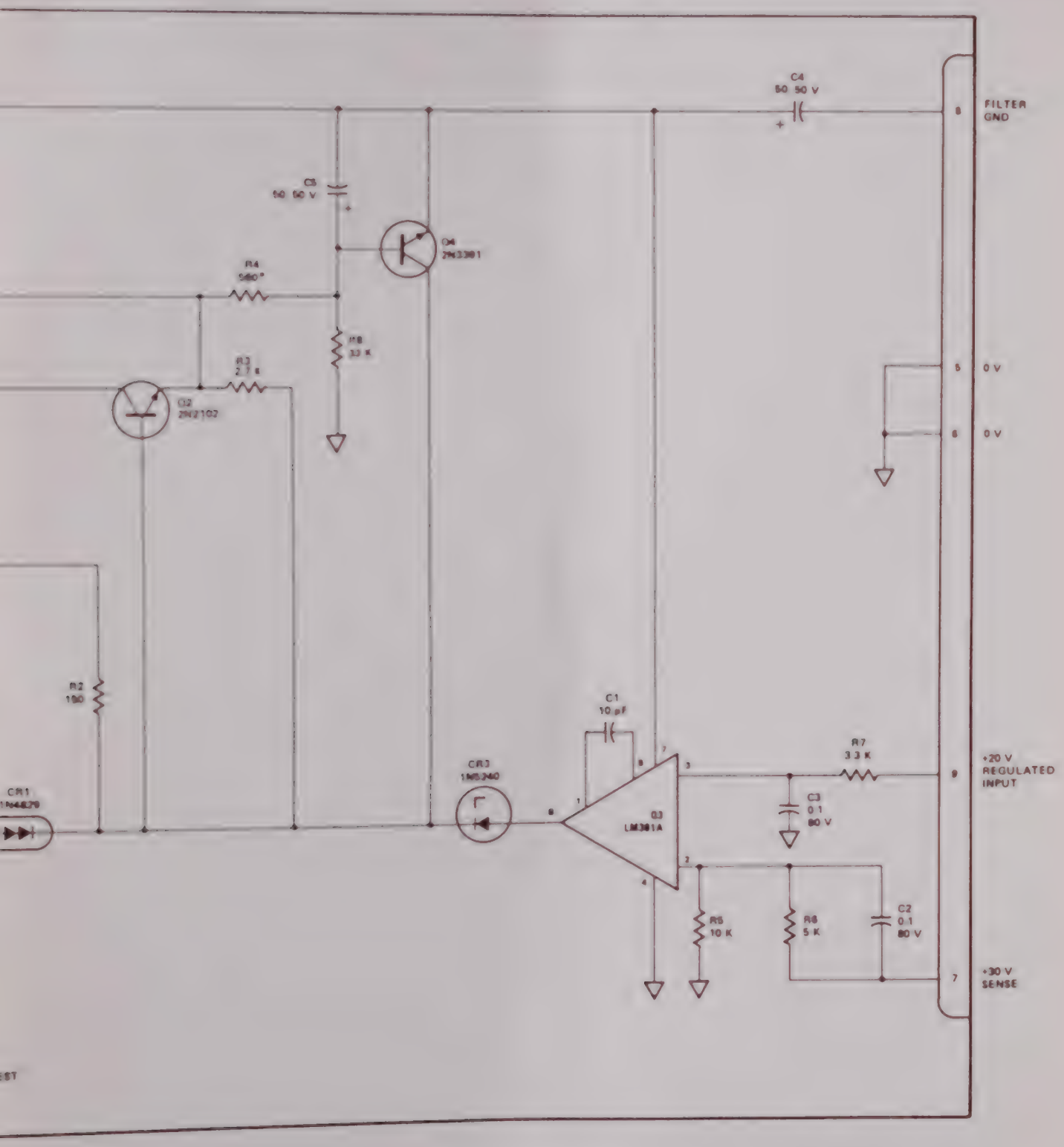
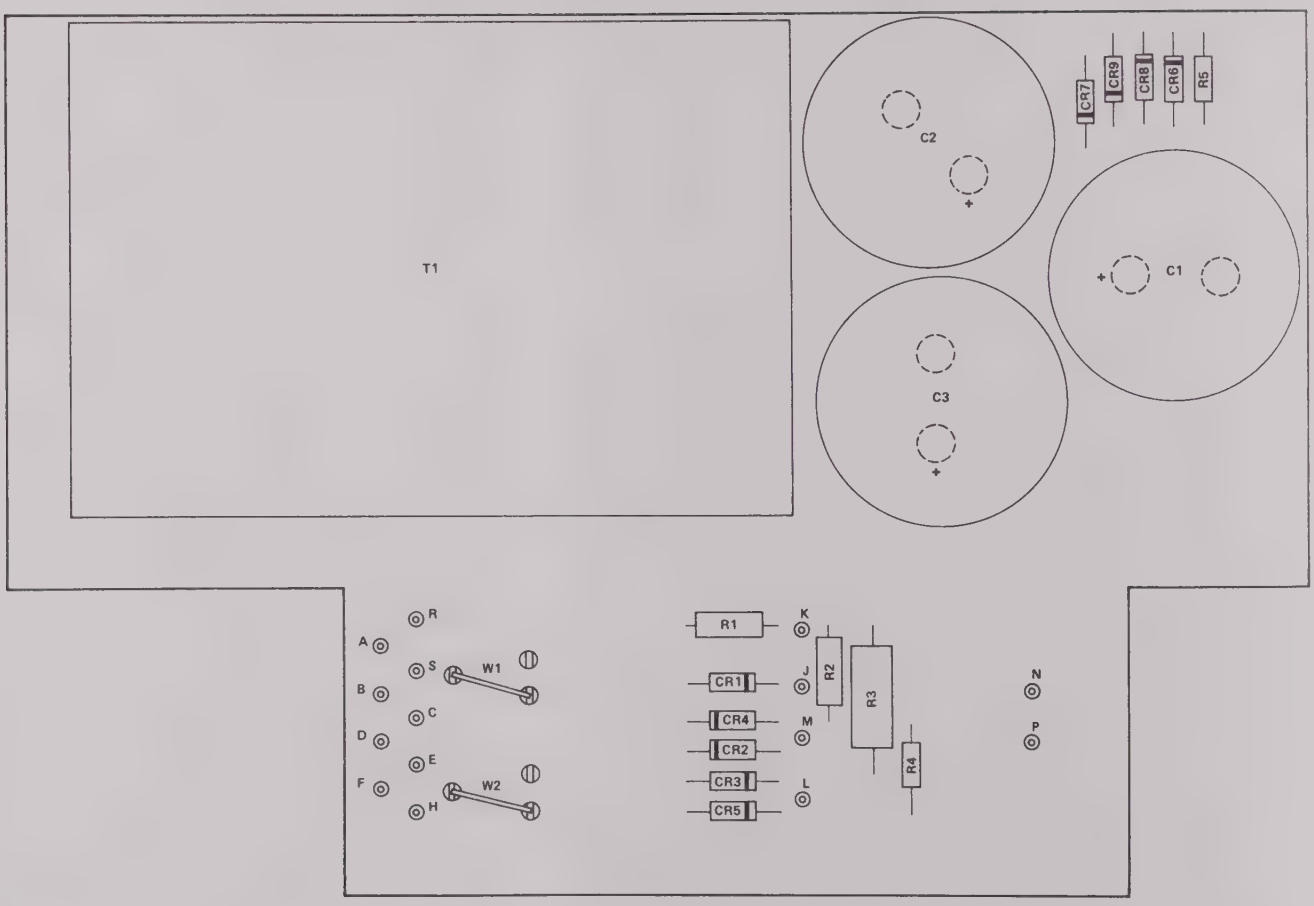


Figure 8-9. Single Precision Regulator Board Assembly A6 Parts Location/Schematic Diagram

K
A

ALL DIODES


T1
C2
+
CR7
CR9
CR8
CR6
R5
C1
+
C3
+
R
A
S
W1
B
C
D
E
F
W2
H
R1
K
CR1
J
R2
R3
CR4
M
CR2
CR3
L
CR5
R4
N
P

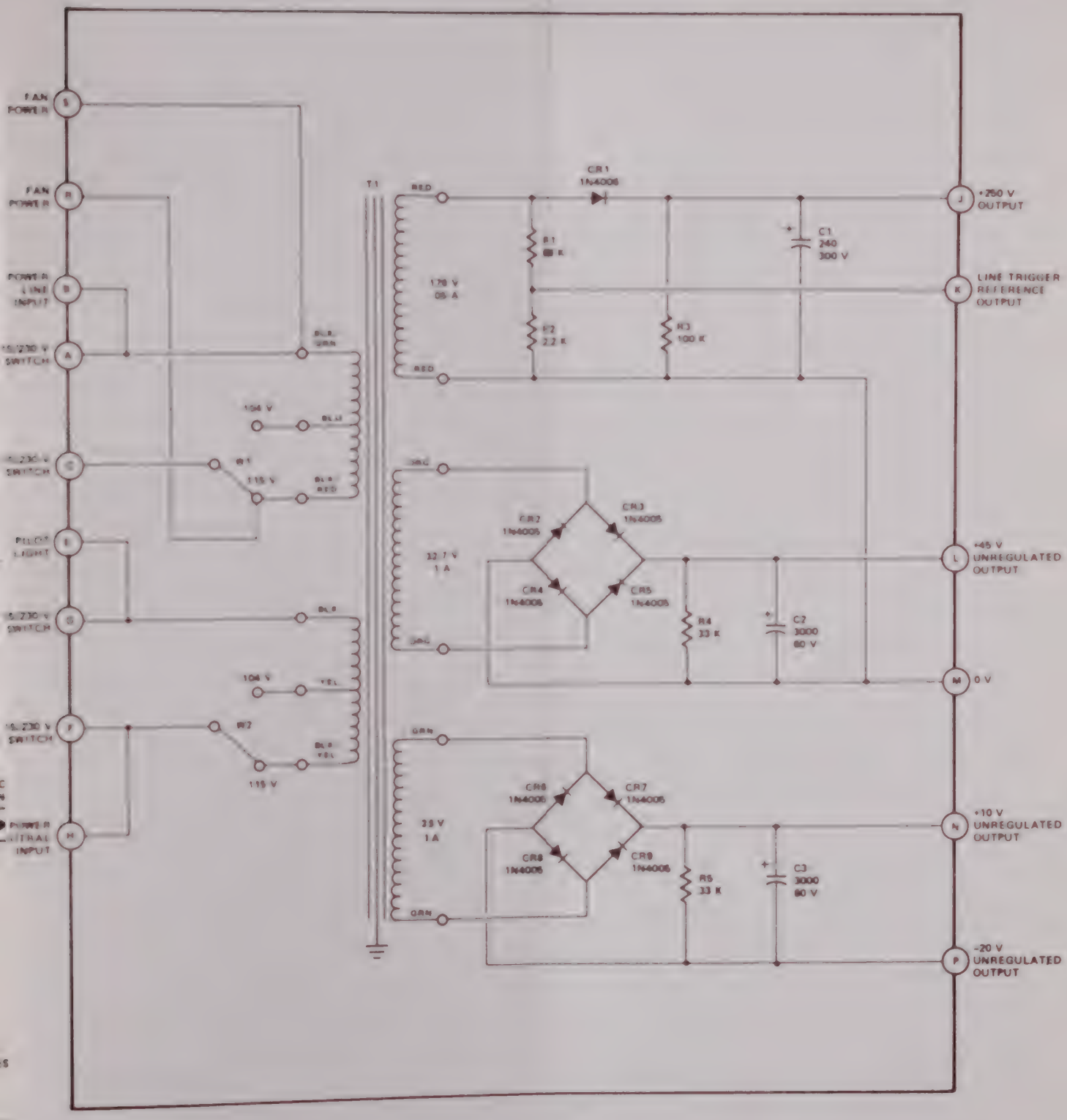
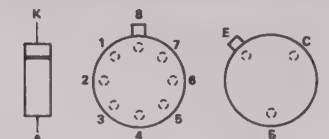
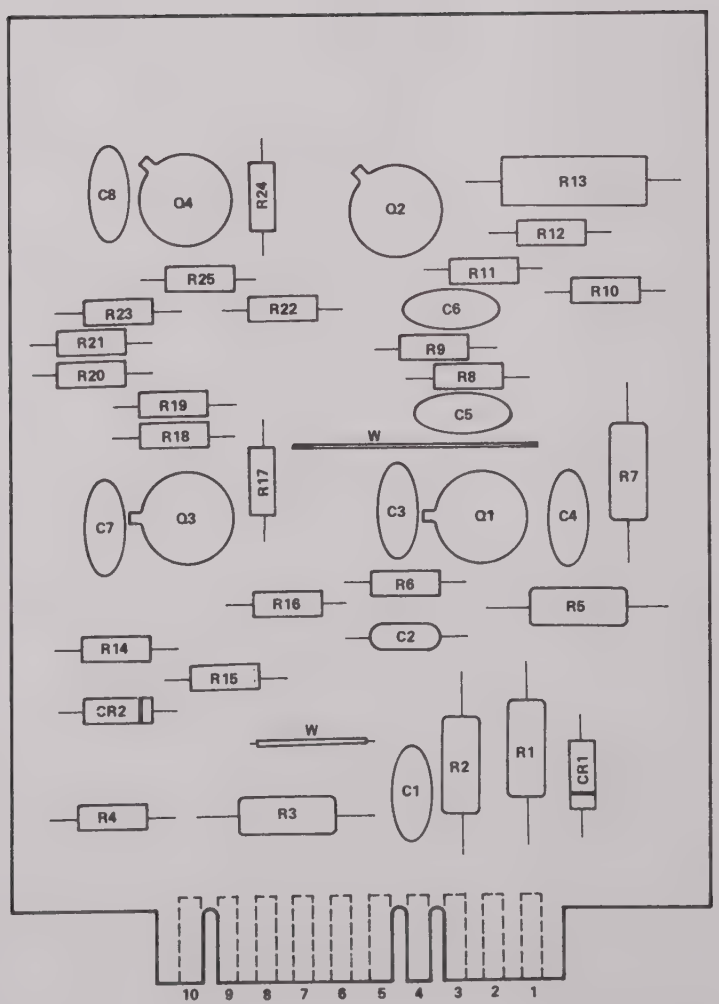
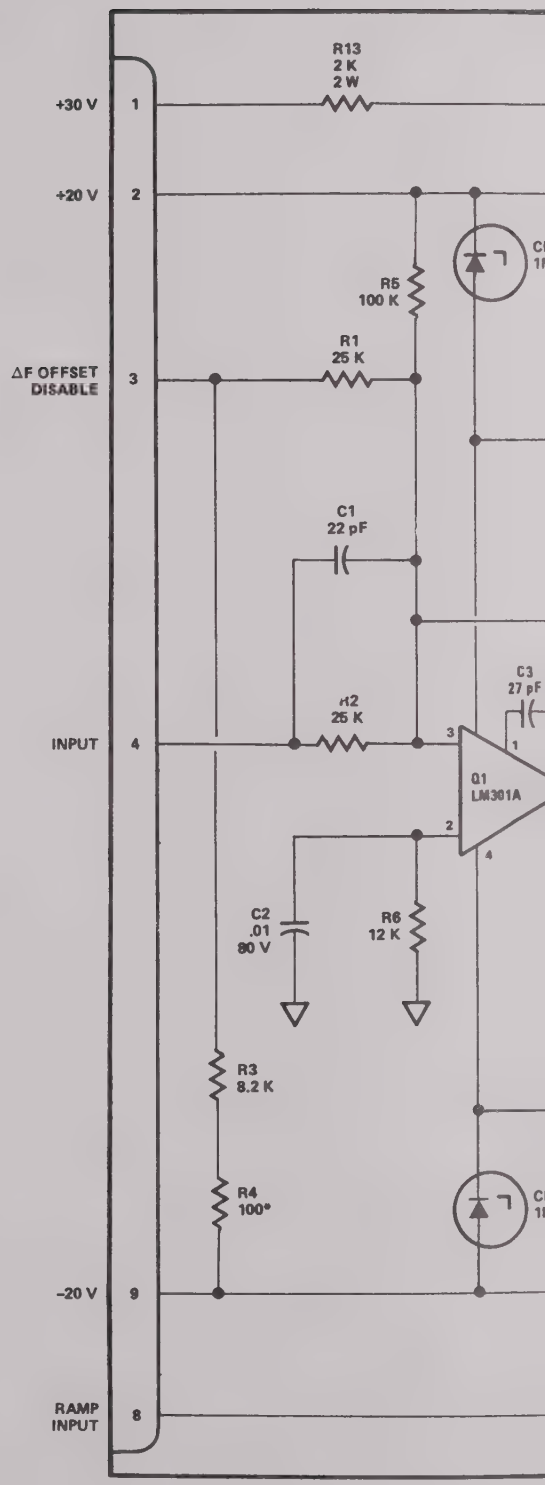


Figure 8-10. Power Supply Board Assembly A7 Parts Location/Schematic Diagram

VIEWS FROM TOP OF SEMICONDUCTOR DEVICE







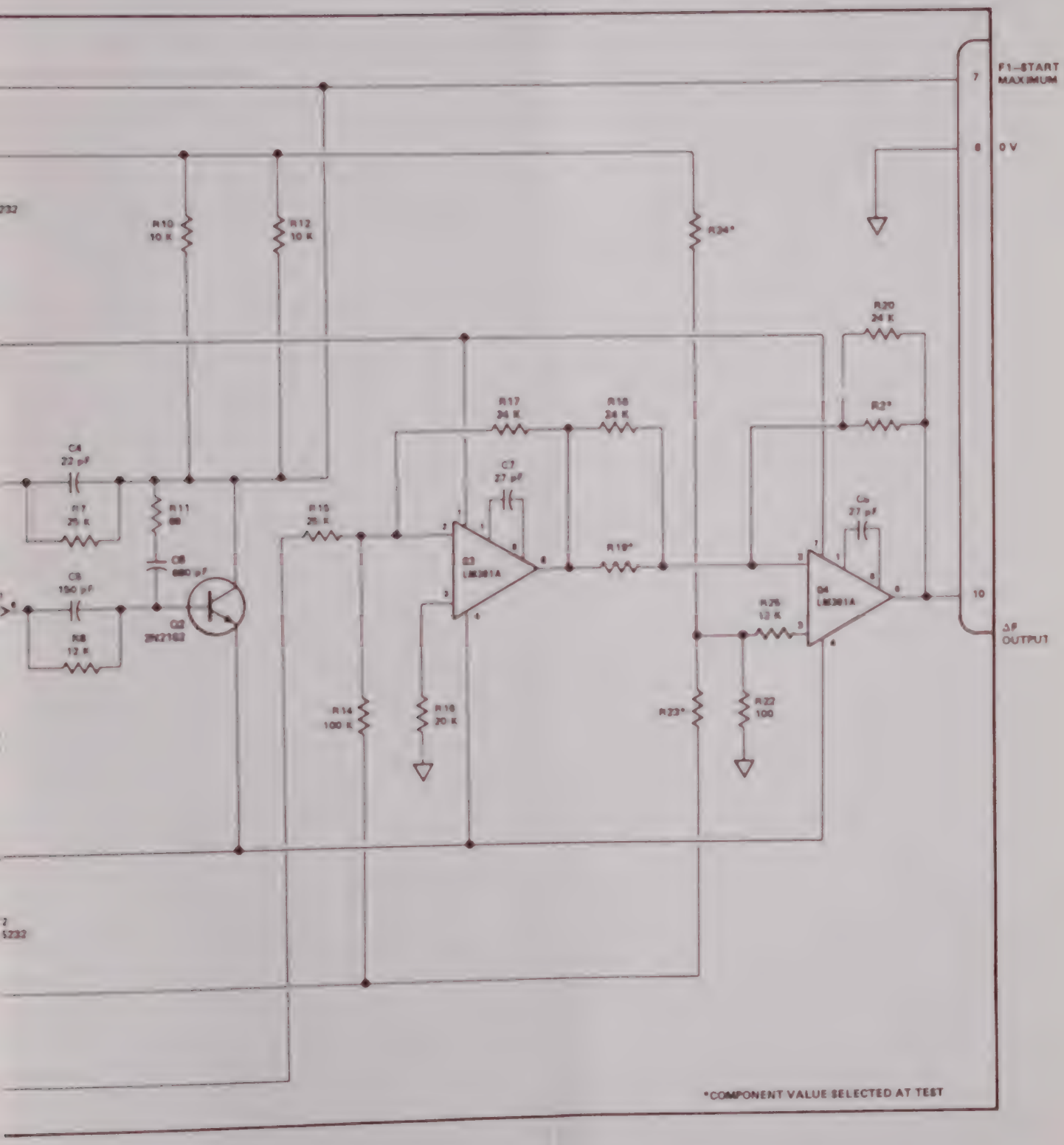


Figure 8-11. Dual Operational Amplifier Board Assembly A8 Parts Location/Schematic Diagram

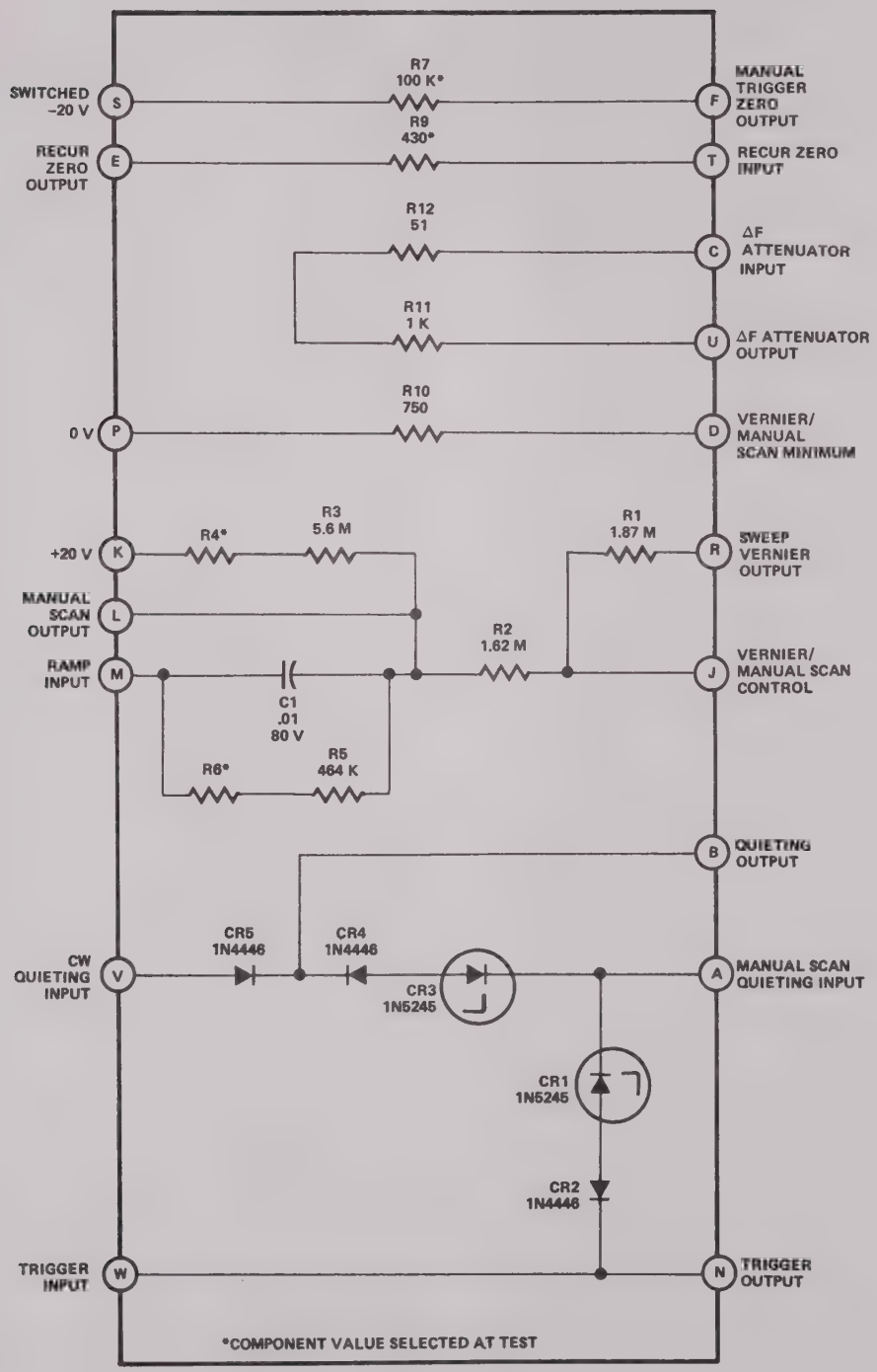
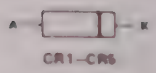
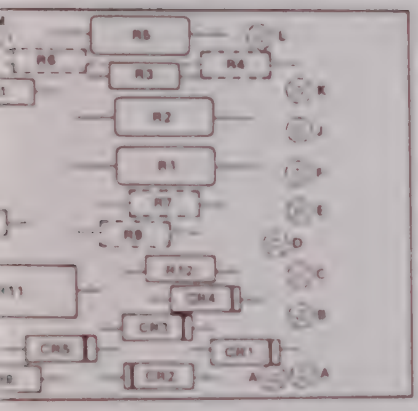


Figure 8-12. Sweep-Second Board Assembly A9 Parts Location/Schematic Diagram

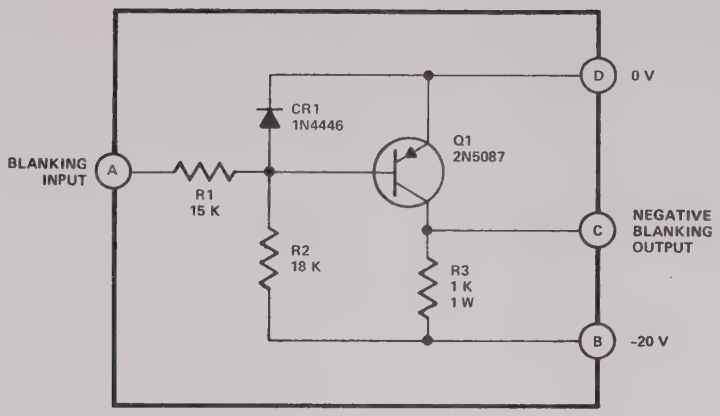




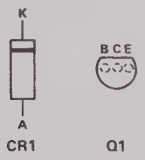
A9

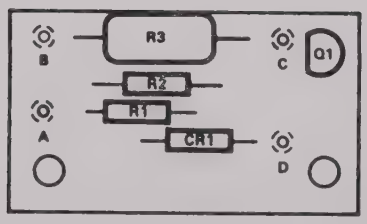
A10

Figure 8-13. Overcurrent Limit Board Assembly A10 Parts Location/Schematic Diagram



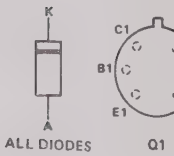
VIEWS FROM TOP OF SEMICONDUCTOR DEVICE

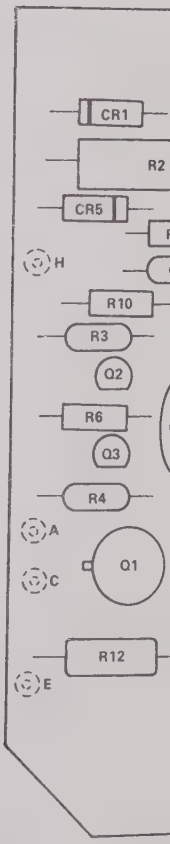




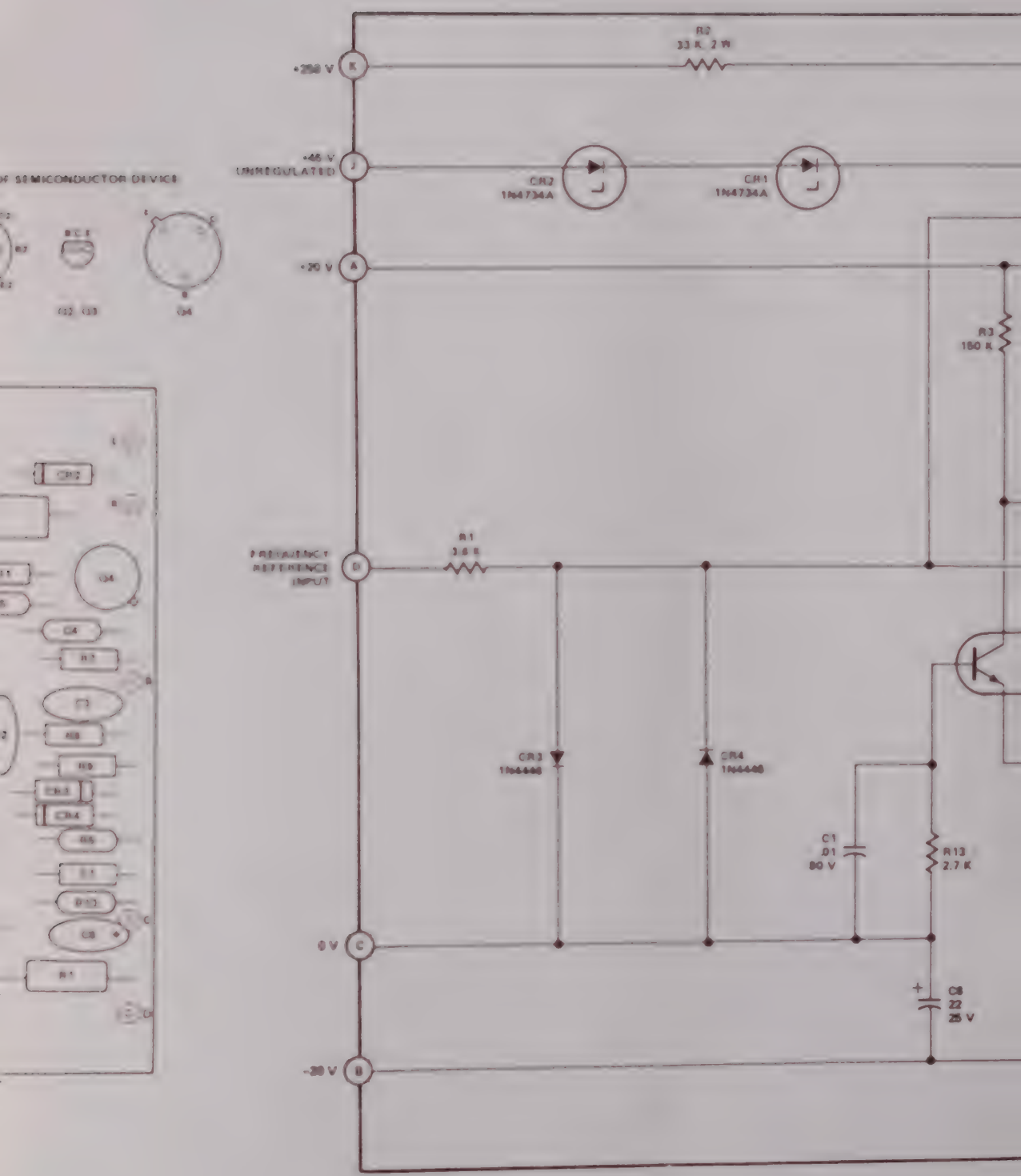
A13 OPTION M1 NEGATIVE BLANKING ASSEMBLY 950025

VIEWS FROM TOP





A14 OPTION M3 F



OSITIVE REFERENCE OUTPUT ASSEMBLY 950269

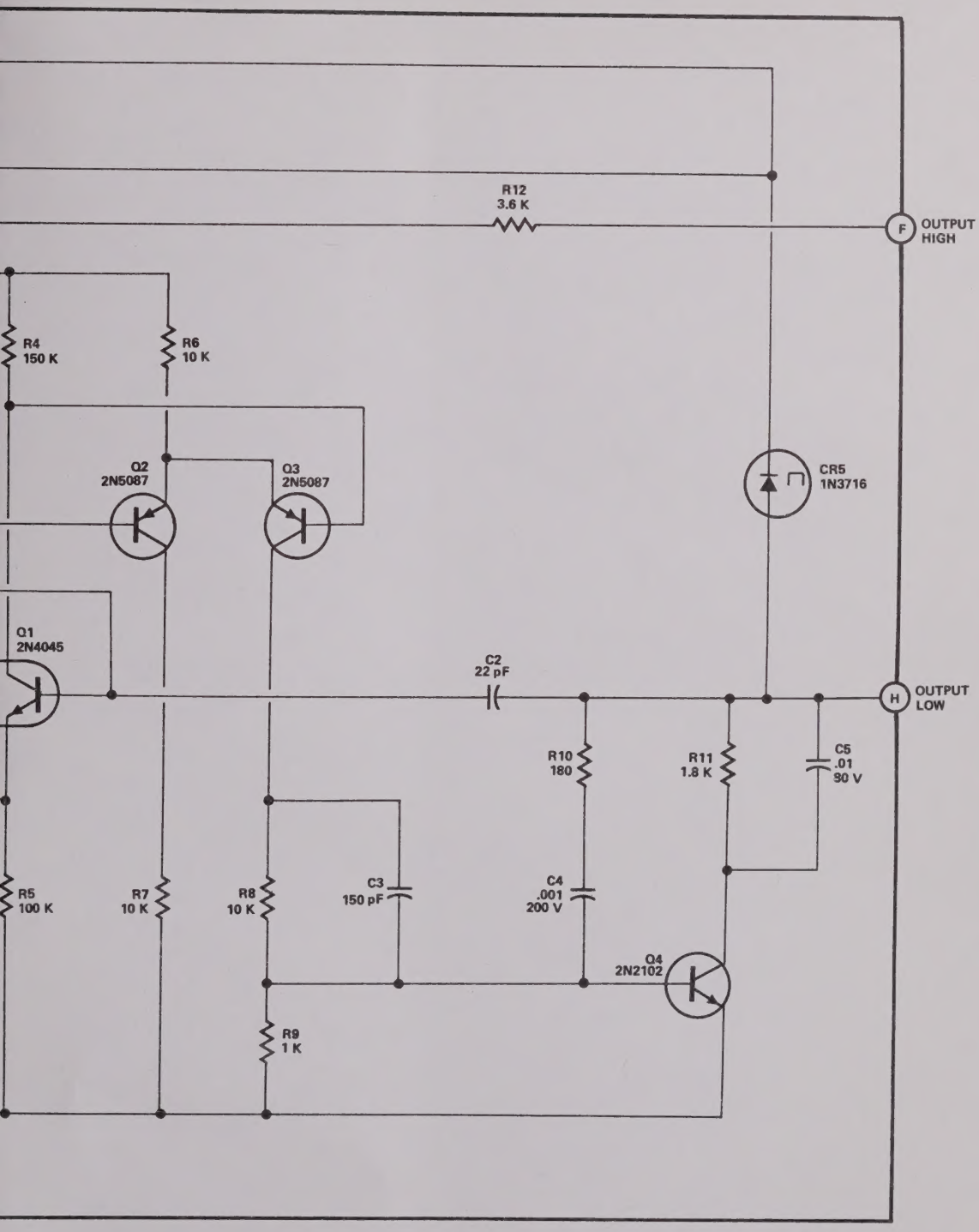


Figure 8-14. Model 5000A Options Parts Location/Schematic Diagrams